JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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Contents

* Withdrawn for publication elsewhere.

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TWENTY-FOURTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Washington, D. C., December 27–29, 1911

The twenty-fourth annual meeting of the American Association of Economic Entomologists will be held in Washington, D. C., December 27–29, 1911. The opening session will be called to order at 1.30 p. m., Wednesday, December 27. The meeting will be continued on Thursday in the morning and afternoon and the final session will be held at 10.00 a. m., Friday, December 29.

The meetings of this Association will be held in the New National Museum in rooms near the Division of Insects.

Other Meetings

The American Association for the Advancement of Science and its affiliated societies will hold meetings throughout the week.

The Entomological Society of America will meet on Tuesday, December 26 and on Wednesday morning. The public lecture before that society will be given Wednesday evening.

The American Association of Official Horticultural Inspectors will meet Thursday evening at 8 p. m., and the meeting will be continued on Friday afternoon and evening.

Hotel Headquarters

Hotel headquarters for this Association have been secured at the Ebbitt House, corner of 14th and F Street, N. W. This hotel is centrally located and is within easy reach of the place of meeting and points of interest. Rates, $1.50 to $4.00 a day on the European plan and $3.00 a day on the American plan.

Members are urged to secure hotel reservations as far in advance as possible, as this will be to the advantage of all concerned.

Railroad Rates

The following information concerning railroad rates has been furnished by Dr. L. O. Howard, permanent secretary, American Association for the Advancement of Science:

A railroad rate of one fare and three-fifths for the round trip, on the certificate plan, has been granted by the Trunk Line Association, the Eastern Canadian and the New England Passenger Associations (not including the Bangor and Aroostock R. R. and the Eastern and the Metropolitan Steamship Companies).

The Southwestern Passenger Association offers no special rate, but advises members to take advantage of the "Christmas Holiday Excursion Rates," the dates of sale being December 15, 16, 17 and 21 to 25, inclusive, with final return date of January 8, 1912.

From the States of California, Nevada, Oregon, Washington and west of, including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine Months' Tourists' fares, approximating two cents per mile in each direction, or about one fare and one-third for the round trip. The nine months' fares apply to the eastern gateways of the Transcontinental territory, and station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine months' tickets in rebuying through to Washington.

The following directions are submitted for the guidance of members traveling on the Certificate Plan from the territories of the *Trunk Line Association* and the *New England* and the *Eastern Canadian Passenger Associations:*

1. Tickets at full fare for the *going* journey may be secured within three days (exclusive of Sunday) prior to, and during the first three days of the meeting. The advertised dates of the meeting are December 26 to December 30, 1911, consequently, you can obtain your tickets not earlier than December 22, 1911, and not later than December 28, 1911.

From points located at a great distance, from which it takes more than three days to reach Washington, going tickets may be purchased on a date which will permit members to reach Washington by December 26, 1911.

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of the train.

3. Certificates are not kept at all stations. If you inquire at your station you will find out whether certificates and through tickets can be obtained to the place of meeting. If not obtainable at your home station, your agent will inform you at what station they can be obtained. You can in such case purchase a local ticket thence, and there purchase through ticket and secure certificate to place of meeting. Be sure that, when purchasing your going ticket, you request *a certificate. Do not make the mistake of asking for a receipt.*

4. On your arrival at the meeting, present your certificate to Mr. F. S. Hazard, assistant secretary. It has been arranged that the special agent of the Trunk Line Association will be in attendance at the office of the Permanent Secretary, New Willard Hotel, to validate certificates daily (9 a. m. to 6 p. m.) from Wednesday to Saturday, December 27 to 30, 1911, both dates inclusive. *A fee of 25 cents will be charged at the meeting for each certificate validated.* If you arrive at the meeting and leave for home prior to the special agent's arrival, or if you arrive at the meeting later than December 30, after the special agent has left, you cannot have your certificate validated and consequently you will not get the benefit of the reduction on the home journey. *No refund of fare will be made on account of failure to have certificate validated.*

If the necessary minimum is in attendance, and your certificate is duly validated, you will be entitled, up to and including January 3, 1912, to a continuous passage ticket to your destination via the route over which you made the going journey, at three-fifths of the limited fare.

Announcement Concerning Dues

Each member attending the meeting on payment of all dues, including those for 1912, will be supplied with the official button of the Association, which will be furnished by the secretary.

PROGRAM

Wednesday, December 27, 1.30 p. m.

Report of the secretary.

Report of the executive committee, by President Washburn.

Report of the committee on nomenclature, by Herbert Osborn, chairman, Columbus, Ohio.

Report of the committee on testing proprietary insecticides, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation with agricultural organizations, by Lawrence Bruner, chairman, Lincoln, Neb.

Report of the committee on legislation, by T. B. Symons, chairman, College Park, Md.

Report of the committee on affiliation of the Horticultural Inspectors with the American Association of Economic Entomologists, by T. B. Symons, chairman, College Park, Md.

Report of the committee on entomological investigations, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on employment bureau for entomologists, by President Washburn, chairman.

Appointment of committees.

Miscellaneous business.

Action on the proposed amendment to article 3 of the By-laws so that section 1 will read as follows: "The annual dues of active members shall be $2.00 and of associate members, $1.50, which shall be payable in advance, the same to include a subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY. No dues shall be payable from foreign members but they shall be charged $1.50 for the JOURNAL if they desire it."

New business.

Annual address of the president, F. L. Washburn, St. Anthony Park, Minn.

Reading of Papers

"Methods in Photographing Insects," by W. C. O'Kane, Durham, N. H. Lantern. (12 minutes.)

"Pellagra and the Sand Fly," by S. J. Hunter, Lawrence, Kan. (15 minutes.)

A series of experiments and investigations to determine what part, if any, this insect plays in the transmission of Pellagra.

"Some Problems of Mosquito Control in the Tropics," by Allan H. Jennings, Washington, D. C. (15 minutes.)

Adjournment.

Program

Thursday, December 28, 10 a. m.

Reading of Papers

"The Date when Wheat Should be Sown to Escape the Fall Brood of Hessian Fly," by T. J. Headlee, Manhattan, Kan. (10 minutes.)

A brief discussion of the factors which determine this date in the light of three years' experimental tests.

"The Corn Bill Bug (*Sphenophorus callosus*)," by R. I. Smith, West Raleigh, N. C. (15 minutes.)

A biological study of this insect, including records of egg-laying, hatching, rearing, etc.

Discussion to be led by F. M. Webster, Washington, D. C.

"Wire Worms in Corn and Potatoes," by O. A. Johannsen, Orono, Me. (5 minutes.)

A summary of the work done at Highmore Farm, Maine, with poisons and repellants and a discussion of crop rotation with a view of obtaining suggestions for continued experiments.

"Grasshopper Work in Minnesota for the Season of 1911," by F. L. Washburn, St. Anthony Park, Minn. (12 minutes.)

Brief review of conditions, experiments and remedial measures employed.

Discussion to be led by Lawrence Bruner, Lincoln, Neb., and C. P. Gillette, Fort Collins, Colo.

"The Outbreak of *Alabama argillacea* Hbn. in 1911," by W. D. Hunter, Dallas, Texas. (10 minutes.)

A brief description of the very unusual outbreak in 1911 and its probable causes.

"The Work in Peru Against the White Scale of Cotton," by C. H. T. Townsend, Piura, Peru. (15 minutes.)

Outline of the parasites so far used and their shortcomings due to the particular conditions here present, with plans of the work for the future.

"The Cotton Square-weevil of Peru and its Parasites," by C. H. T. Townsend, Piura, Peru. (15 minutes.)

Additional data on the weevil, with an enumeration of the parasites reared from infested squares and bolls to date.

"Natural Control of Aleyrodid Pests of Citrus in Florida," by E. A. Back, Blacksburg, Va. (15 minutes.)

Results of Experiments conducted by U. S. Bureau of Entomology.

Adjournment.

Program

Thursday, December 28, 1.30 p. m.

Reading of Papers

"Insecticides for Use in Controlling the White Fly," by W. W. Yothers, Orlando, Fla. (15 minutes.)

Discusses the successful use of insecticides against this pest.

"Ortho-Arsenite of Zinc as an Insecticide," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

A comparison of this insecticide with Paris green and arsenate of lead with respect to (*a*) injury to the bark of the apple, (*b*) settling in water with and without soap, (*c*) killing power and (*d*) cost. The results indicate a promising insecticide.

"Some Results of Lime-Sulfur Research in Oregon," by A. B. Cordley, Corvallis, Ore. (15 minutes.)

Discussion to be led by P. J. Parrott, Geneva, N. Y.

"The Susceptibility of Adults and Eggs of Pear Psylla to Spraying Mixtures," by P. J. Parrott and H. E. Hodgkiss, Geneva, N. Y. (To be read by title.)

Discussion of a large number of experiments to determine the effects of various sprays on adults, eggs and nymphs.

"The Efficiency of the Driving Spray for the Codling Moth," by E. D. Ball, Logan, Utah. (15 minutes.)

Results of extensive tests, with a general discussion of the methods of determining the actual and comparative efficiency of a given spray.

"Recent Experiments with the Codling Moth," by E. P. Felt, Albany, N. Y. (10 minutes.)

Brief discussion of the results obtained by spraying this year in comparison with those of the two preceding seasons.

Discussion to be led by A. L. Quaintance, Washington, D. C.

"A Third Brood of the Codling Moth in Kansas," by L. M. Peairs, Manhattan, Kan. (10 minutes.)

Evidence from the season's work in Kansas orchards shows a large third brood of this moth.

"Spread of the Leopard Moth in Connecticut and its Injury to Shade Trees," by W. E. Britton, New Haven, Conn. (10 minutes.)

Brief account of its spread and notes on injury to the different kinds of trees.

"Notes on the Control of Three Shade Tree Pests," by Glenn W. Herrick, Ithaca, N. Y. (10 minutes.)

"Some Shade Tree Pests in Eastern Massachusetts," by A. F. Burgess, Melrose Highlands, Mass. (15 minutes.)

"Progress in Exterminating Two Isolated Gypsy Moth Colonies in Connecticut," by W. E. Britton, New Haven, Conn. (10 minutes.)

Brief account with figures showing time, force and funds used to produce the results obtained.

Adjournment.

Program

Friday, December 29, 10 a. m.

Reading of Papers

"The Gooseberry Gall Midge or Bud Deformer (*Rhopalomyia grossulariæ* Felt)," by J. S. Houser, Wooster, Ohio. (12 minutes.)

Brief notes concerning occurrence and life history.

"Occurrence of the Pear Thrips in New York," by P. J. Parrott, Geneva, N. Y. (15 minutes.)

Circumstances of discovery, distribution and spray experiments.

"Some Experiments to Determine the Effects of Roentgen Rays on Insects," by W. D. Hunter, Dallas, Texas. (10 minutes.)

Deals largely with tests to determine the sterilizing effects of the rays.

"Insects of the Year in Massachusetts," by H. T. Fernald, Amherst, Mass. (5 minutes.)

"The More Important Injurious Insects in 1911 in Nebraska," by Myron H. Swenk, Lincoln, Neb. (5 minutes.)

"Insects Especially Injurious in Virginia during 1911," by E. A. Back, Blacksburg, Va. (5 minutes.)

"Injurious Insects in 1911 at Treesbank, Manitoba," by Norman Criddle, Treesbank, Manitoba, Canada. (10 minutes.)

Final Business Session

Report of committee on auditing.
Report of committee on resolutions.
Report of committee on memorial resolutions.
Report of committee on membership.
Report of other committees.
Report of committee on nominations.
Election of officers.
Miscellaneous business.
Fixing the time and place of the next meeting.
Final adjournment.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

F. L. Washburn, *President*,
St. Anthony Park, Minn.

PRELIMINARY PROGRAM OF THE TENTH ANNUAL MEETING AMERICAN ASSOCIATION OF OFFICIAL HORTICULTURAL INSPECTORS

Washington, D. C., December 28 and 29, 1911

First Session—Thursday 8 p. m.

Organization.

Report of Secretary, T. B. Symons, College Park, Md.

President's Annual Address, Franklin B. Sherman, Raleigh, N. C.

"What Should the State Require of a Neglectful Owner of a Dangerous Orchard," Dr. S. A. Forbes, Urbana, Ill.

Report of Committee on National Legislation, T. B. Symons, Chairman.

Miscellaneous Business.

Second Session—Friday 1 p. m.

"Exempting Certain Species of Plants from Fumigation for San José Scale," S. A. Green, Urbana, Ill.

"Enforcing Fumigation and the Attitude of Nurserymen and Growers to the Treatment," T. B. Symons, College Park, Md.

"The Chestnut Bark Disease." Dr. Haven Metcalf, U. S. Dept. of Agriculture.

"The Stopping Back of Peach Trees Due to Bud Mites," H. A. Surface, Harrisburg, Pa.

"Dangerous Foreign Diseases Liable To Be Imported on Plants," Dr. Perley Spaulding, U. S. Dept. of Agriculture.

Discussion.

Third Session—8 p. m.

"The Present Status of Crown Gall," J. B. S. Norton, College Park, Md.

"Recent Importations of Dangerous Foreign Insect Pests," C. L. Marlatt, U. S. Dept. of Agriculture.

"A Recent Decision of the Supreme Court of Kansas," S. J. Hunter, Lawrence, Kan.

Questions for Discussion

1. Is it desirable that the inspection laws and service of a state should be made to include the quality and variety of nursery stock, in a way to insure the purchaser so far as practicable against fraudulent transactions or exorbitant prices?

2. What is the best general practice to follow in orchard inspection work?

3. *a*—What ought to be the attitude of inspectors towards nursery stock brought into a state or sections of a state that are free from gipsy moth?

   b—Same, relative to brown tail moth?

   c—What should be the attitude of inspectors relative to nursery stock slightly infested with scale that is planted in areas of a general infestation.

   d—What should inspectors do to prevent the spread and distribution of chestnut bark disease?

4. Some problems in connection with the interstate commerce law.

A complete program will be mailed to all members of this Association. It is hoped that the horticultural inspectors of the country will plan to attend this meeting as there are many very important questions requiring our united action.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 4 FEBRUARY, 1911 No. 1

Proceedings of the Twenty-Third Annual Meeting of the American Association of Economic Entomologists

The twenty-third annual meeting of the American Association of Economic Entomologists was held in the School of Mines Building of the University of Minnesota, Minneapolis, Minn., December 28, 1910, and on the following day the sessions were held in the rooms of the State Entomologist of Minnesota, on the grounds of the State Agricultural College.

Part I of this report contains the business proceedings, and the addresses, papers and discussions will be found in Part II.

PART I

The meeting was called to order by President E. D. Sanderson at 10 a. m. on Wednesday, December 28. The average attendance at the sessions was fifty members and visitors. The following members were present:

E. A. Back, Blacksburg, Va.; G. M. Bentley, Knoxville, Tenn.; Lawrence Bruner, Lincoln, Neb.; A. F. Burgess, Melrose Highlands, Mass.; E. C. Cotton, Knoxville, Tenn.; J. J. Davis, Chicago, Ill.; G. A. Dean, Manhattan, Kansas; E. B. Engle, Harrisburg, Pa.; H. A. Gossard, Wooster, Ohio; T. J. Headlee, Manhattan, Kan.; L. O. Howard, Washington, D. C.; S. J. Hunter, Lawrence, Kan.; F. B. Lowe, Detroit, Mich.; O. W. Oestlund, Minneapolis, Minn.; W. C. O'Kane, Durham, N. H.; Herbert Osborn, Columbus, Ohio; H. T. Osborn, Wellington, Kan.; Edith M. Patch, Orono, Me.; W. J. Price, Jr., Blacksburg, Va.; A. G. Ruggles, St. Anthony Park, Minn.; C. E. Sanborn, Stillwater, Okla.; J. G. Sanders, Madison, Wis.; E. D. Sanderson, Morgantown, W. Va.; G. D. Shafer, East Lansing, Mich.; N. E. Shaw, Columbus, Ohio; J. B. Smith, New Brunswick, N. J.; H. E. Summers, Ames, Iowa; M. H. Swenk, Lincoln, Neb.; T. B. Symons, College Park, Md.; T. D. Urbahns, St. Anthony Park, Minn.; R. A. Vickery, Washington, D. C.; F. L. Washburn, St. Anthony Park, Minn.; R. L. Webster, Ames, Iowa, and L. H. Worthley, Boston, Mass.

President Sanderson: The first business on the program is the report of the secretary, by Mr. A. F. Burgess.

REPORT OF THE SECRETARY

At the close of the year 1909, the membership of the Association was made up as follows: Active 118, associate 124 and foreign 46. At the Boston meeting thirteen associate and one foreign member were transferred to the active list and thirty-six associate and three foreign members were elected. One active member resigned at that meeting and one active and one associate member have died during the year which is just closing. At the last meeting the secretary was instructed to notify nine active and ten associate members, who were in arrears for dues for three years, that unless payment was made their names would be dropped from the roll. This has been done and four active and eight associate members have been dropped. The present membership is 126 active, 138 associate and 48 foreign members. A net increase of 24.

From the number of applications for membership received it is evident that a moderate growth in membership will result at this meeting.

The Association has lost through death Mr. G. W. Kirkaldy, the well-known Hemipterist and assistant entomologist to the Hawaiian Sugar Planters' Experiment Station at Honolulu and Mr. J. A. West, who for several years had been assistant to the state entomologist of Illinois.

One of the most difficult features of arranging for the annual meeting is to make up the program in such a manner that the members who prepare papers will have a reasonable amount of time to present them and so that important discussions will not be curtailed so that little of value will result. For a number of years it has been customary to hold sessions for two days and when this practice commenced the number of papers presented afforded sufficient time for them and the transaction of the business of the Association. During the last few years the number of titles submitted is far too great for a meeting of two days and it appears that the time has now arrived when only a limited number of papers can be accepted for the program or the number of sessions of the meeting must be extended so that all members who present papers or wish to attend the meetings will be assured of a proper hearing.

Financial Statement

Balance on hand December 28, 1909		$121.19
By amount received for dues, 1910		191.50
To stenographic report 1909 meeting	$15.00	
stamps and stamped envelopes	41.23	
printing	32.97	
photo and express	2.85	
supplies	1.00	
telegraph and express charges	3.59	
clerical work, secretary's office	18.00	
compensation of secretary	50.00	
	164.64	
Balance in treasury December 24, 1910	148.05	
	$312.69	$312.69

Respectfully submitted,

A. F. Burgess,
Secretary.

PRESIDENT SANDERSON: What is your pleasure as regards the report of the secretary?

Moved and seconded that it be adopted.

SECRETARY BURGESS: I would request that the motion be amended so that the financial part of the report can be referred to the auditing committee.

By vote of the Association the amended motion was adopted.

PRESIDENT SANDERSON: The report of the committee on the matter of control of imported nursery stock is now in order. Mr. Symons, are you ready to report?

MR. SYMONS: This is not on the program but I would like to have it taken up later.

PRESIDENT SANDERSON: The next business is the report of the committee on testing proprietary insecticides. In behalf of this committee I will say that no meeting has been held. A report was made and published in the JOURNAL after the passage of the National Insecticide Law last spring. Since that time no work has been done. I believe there is a field for an insecticide committee, but would like to see the present one discharged and a new committee nominated. There is no further report to make at the present time.

MR. LOWE: Concerning insecticides, has this standing committee had any insecticides submitted for tests?

PRESIDENT SANDERSON: Not this past year. Two years ago some insecticides were submitted to us, and the committee at that time made its report.

MR. LOWE: I allude to the recommendation of the standing committee on insecticides, that the insecticides be first tested by the manufacturers and then submitted for corroboration. In regard to the insecticide law, I have looked into that very carefully, and there are several things I notice, in connection with the law that are liable to come up some time.

PRESIDENT SANDERSON: I would say, that this should properly be taken up with the United States Bureau of Chemistry.

President Sanderson next presented the report of the Executive Committee.

REPORT OF THE EXECUTIVE COMMITTEE

December 28, 1910.

To the American Association of Economic Entomologists:

GENTLEMEN, Your Executive Committee has been unable to hold a meeting, but has conducted its work by correspondence and begs to present the following unanimous report:

1. Your committee has voted the necessary expense for clerical help for the secretary and an honorarium of $50 for 1910, as authorized by the last meeting. Your

committee feels that the financial condition of the Association and the duties devolving upon the secretary both warrant such slight remuneration. We would recommend that it be the future policy of the society to pay the expenses of the secretary to the annual meeting provided his expenses are not paid by the institution by which he is employed, and that in lieu of such expenses or in addition to them, the executive committee be empowered to vote the secretary such annual honorarium as the financial condition of the Association may warrant.

2. Your committee recommends the establishment of a standing committee on "Entomological Investigations." It is contemplated that it would be the duty of said committee to secure reports from the heads of all entomological departments represented in the Association, as to the work in progress and the work contemplated for the following year. Such reports would be gathered during the late fall and a summary published in the December issue of the JOURNAL OF ECONOMIC ENTOMOLOGY or presented at the annual meeting, so that the information so received would furnish the basis of personal conferences between different workers along similar lines at the annual meeting. As indicative of the work of such a committee we have secured a report along these lines through the coöperation of Dr. T. J. Headlee which will be presented at this meeting.

3. Your committee recommends that the incoming executive committee be instructed to submit an amendment to Article III of the By-Laws as required by Article 5 of the By-Laws, so that Article III shall provide that the annual dues of active members be $2 and of associate members $1.50, the same to include a subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY, and that foreign members be charged no dues, but that they be charged $1.50 as subscription for the JOURNAL OF ECONOMIC ENTOMOLOGY if they desire it.

This proposed amendment anticipates that the Journal of Economic Entomology Publishing Company, will elect the secretary of the Association of Economic Entomologists as secretary-treasurer, *ex officio* business manager, and would provide certain compensation for that official by the Publishing Company. It seem to your committee that an informal discussion of the proposed arrangement might be advisable at the present meeting, so that the plan might be fully understood and carefully considered during the coming year.

Respectfully submitted,

E. D. SANDERSON, *President.*
H. T. FERNALD, *First Vice-President.*
P. J. PARROTT, *Second Vice-President.*
A. F. BURGESS, *Secretary.*

PRESIDENT SANDERSON: What is your pleasure in regard to this report, will you act on it now or, take it up later?

By general consent action on the report was postponed until the final business session.

PRESIDENT SANDERSON: We will next listen to the report of the Committee on Affiliation by Mr. Bruner.

MR. BRUNER: This report was made by Doctor Hopkins, as I was unable to be present at the Washington meeting.

REPORT OF THE COMMITTEE ON AFFILIATION OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Prepared and presented at the joint meeting of Committees, November 15, 1910, by A. D. Hopkins.

The American Association of Economic Entomologists has given the matter of affiliation considerable attention. In the proceedings of the meeting held at Baltimore in December, 1908, about five pages are devoted to reports of committees and to discussions relating to the matter.

A committee was appointed in 1908 to attend the meeting of the Society for the Promotion of Agricultural Science, held that year at Washington, D. C. Two members of the committee were present and a report made to the Society at its regular session in December of the same year that nothing definite had been accomplished. After a discussion of the matter, the president appointed Lawrence Bruner, A. D. Hopkins, and A. F. Burgess a committee to confer with other committees on affiliation and report at the next meeting; also to present a plan of action for the consideration of the Association before final adjournment. The following plan was presented:

See p. 24, Journal of Economic Entomology, Vol. II, No. 1, February, 1909, p. 24. (Letter Professor Bruner, October 26, quoted in part.)

In expressing my opinion as a member of the committee, it is evident that in order to promote in the best way these common objects and social and business interests, there is special need of some form of affiliation of the various societies in North America which have for their objects the advancement of agriculture through scientific research. Among the needs to be met by affiliation and coöperation, the following may be mentioned:

(a) Economy and efficiency in conducting the special and general sessions; (b) economy and efficiency in publications; (c) economy in membership fees and annual dues.

In conducting the meetings provisions could be made: 1. For securing the best facilities for independent and joint sessions of the various societies and their committees.

2. For classifying the subjects of papers to be presented, and assigning them to the programs of a special society, or the joint programs of two or more societies where they will be of interest to the greatest number of the members in attendance.

3. For the selection of special subjects of the broadest interest and assigning them to the general session of the affiliated societies for discussion.

In regard to economy and efficiency in publications, there is decided need of economy in the aggregate cost of publications issued by the various societies, as there is also of more efficiency in such publications to meet the requirements of the members for classified and condensed information issued in the most convenient and available form for the busy investigator and student.

It is believed that through affiliation and proper coöperation and a common place of publication, with a paid editor to coöperate with the publication committees of the various societies, the cost to the individual members of desirable published matter could be reduced fifty per cent., and that efficiency in such publications could be greatly increased.

As to economy in membership fees and annual dues, there is special need of economy in the aggregate amount of money paid by the scientist to secure the social,

intellectual, and other benefits to be derived from the various organizations relating to the subjects in which he has a special or general interest.

These expenditures consist in membership fees, annual dues, special assessments for social functions, railroad travel, hotel bills, etc., amounting in the aggregate to a considerable sum, and often much larger than the investigators who are giving their time and energies to public service at moderate salaries feel that they can afford.

It is believed that through affiliation and the transaction of the business affairs by a representative permanent committee, the aggregate amount heretofore paid in membership fees and annual dues per individual member can be reduced fifty per cent. or more, and that the facilities for acquiring general and personal benefits and for the advancement of the various specific and general objects of the societies can be increased very materially.

Indeed, there appears to be a feeling among the members of scientific societies generally that a more progressive and economical method of conducting the business of the societies should be adopted.

A. D. Hopkins.

November 14, 1910.

The following general plan of organization is submitted as an appendix to our report:

A PROPOSED AFFILIATION OF SOCIETIES ORGANIZED FOR THE ADVANCEMENT OF AGRICULTURAL SCIENCE

Resolution and Agreement

The authorized representatives of the associations and societies relating to agricultural science present at a meeting held in Washington, D. C., November 15, adopted the following resolution and constitution:

Resolved, That in order to promote common objects and interests there is special need of an affiliation of the various societies in North America which have for their objects the advancement of agriculture through scientific research;

That, therefore, the undersigned representatives of the Association of American Agricultural Colleges and Experiment Stations, American Association of Economic Entomologists, American Association of Farmers' Institute Workers, American Breeders' Association, American Phytopathological Society, American Society of Agronomy, American Society of Animal Nutrition, Association of Dairy Instructors, Association of Horticultural Inspectors, Association of Official Agricultural Chemists, Society for Horticultural Science, and Society for the Promotion of Agricultural Science hereby agree to affiliate under the following constitution, *subject to ratification at the first regular session held by the societies mentioned subsequent to this date.*

[Signed on behalf of the American Association of Economic Entomologists by A. D. Hopkins.]

Constitution

Article I. Name

The name of this organization shall be the Affiliated Societies of Agricultural Science.

Article II. Purpose

The purpose of the affiliation shall be to promote the common interests of the adhering societies, arrange periodically for a common place and time of meeting, promote economy and efficiency in publications, and otherwise to encourage coöperation in the advancement of agriculture through scientific research.

ARTICLE III. Membership

The organization shall consist of national societies which have for their prime object the advancement of agriculture. The societies mentioned in the accompanying resolution shall be charter members. Additional societies may be admitted at any general meeting of the Affiliated Societies.

ARTICLE IV. Organization

The general business of the organization shall be in charge of a Council, to consist of one member elected biennially by each adhering society.

The officers of the Council shall be a president, a vice-president, a secretary, and a treasurer, who shall serve for six months after their successors are elected. These officers shall constitute the officers of the organization.

ARTICLE V. Meetings

A general meeting of the Affiliated Societies shall be held at least biennially, at a time and place to be determined by the Council. Any adhering society may hold meetings at such times and places as it may select, but so far as practicable all should meet together biennially.

ARTICLE VI. Autonomy

Each society shall retain its organization, and shall have entire control of the election of its members and officers and all other matters not specifically delegated by it to the Council of the Affiliated Societies.

ARTICLE VII. Annual Dues

Each society upon becoming a member of the organization shall pay to the treasurer of the Council a *pro rata* sum not to exceed one dollar for each of its members, and a similar amount thereafter annually, the amount in each case to be fixed by the Council. The fiscal year of the Affiliated Societies shall coincide with the calendar year.

ARTICLE VIII. Publications

The Proceedings of the various societies may be issued individually, but all should conform to a uniform style of page, paper and type, in order that they may constitute uniform parts of a set of Transactions of the Affiliated Societies.

The Council may, upon the approval of the adhering societies, superintend the publication of their Proceedings and employ a general editor to coöperate with the editors of the various societies in securing uniformity, economy, and efficiency.

The Council may arrange for the periodical publication of a journal of agricultural science, to contain reports in abstract of the meetings of the societies, brief notices, reviews, and contributions of general interest to the members of the Affiliated Societies, and for the interchange of ideas on important problems of the day relating to agricultural science, this journal to be issued to members at a subscription price to be fixed by the Council.

ARTICLE IX. Amendments

Amendments to this constitution may be made at any general session of the affiliation upon the recommendation of the Council, provided that sixty days' notice of the proposed amendments has been given to the president and secretary of the adhering societies.

ARTICLE X. By-Laws

The Council shall formulate and adopt a set of by-laws to govern its actions under this constitution.

MR. J. B. SMITH: I would like to move that this report be considered at the same time with the report of the Executive Committee. One

reason I make the suggestion is that I am acquainted with the character of the report, and the question of publication is more or less connected with this, so that these two subjects should be considered together. I move that action on this be deferred until later.

The motion prevailed and the consideration of the report was deferred until the next business session.

PRESIDENT SANDERSON: We will now hear the report of the Committee on Nomenclature by Professor Osborn.

MR. HERBERT OSBORN: The committee has no list of names to submit for adoption at this meeting. Few common names of insects have been received during the year but it is the expectation of the committee to submit a list at the next annual meeting.

Voted that the report be accepted.

PRESIDENT SANDERSON: Are there other reports?

SECRETARY BURGESS: Mr. President, I have received quite a number of letters from members who are unable to be present, many of those who have papers on the program are not here, and have forwarded the papers to me. Among them might be mentioned Professor Cooley of Montana. Miss Murtfelt of Kirkwood, Mo., has also sent a short letter and a paper which she has prepared, and states that owing to poor health she is unable to be here. I have papers from Dr. H. T. Fernald and Professor Comstock, which go with the symposium on teaching entomology, and a paper from Mr. Norman Criddle, Treesbank, Manitoba; a letter from Doctor Hewitt, the Dominion Entomologist of Canada, saying he is unable to be present, owing to the fact that he has been traveling over the Dominion for two or three months, and business matters force him to be in another portion of the country at this time; a letter from Doctor Bethune regretting his inability to be present and a short paper from F. W. Urich. Several of the papers are not on the program, for the reason that they came in after the program was printed. I have a title from Charles T. McClintock and Mr. Lowe on "Demonstration of Methods of Testing Ingestion and Contact Insecticides."

At the last meeting of the Association resolutions were passed in regard to the death of members who had passed away during the year previous, and after the meetings were concluded a copy was sent to each one of the families. I received a letter from Mrs. Guilbeau stating her deep appreciation of the action taken.

There is one other matter I think of at this time: At the last meeting a resolution was passed providing for official buttons. This has been done, and buttons have been prepared for the meeting. The idea is to give them out on the same basis that the buttons are given out by the American Association for the Advancement of Science, that is, upon

the payment of dues. The program has been prepared, and in the back of each program has been printed a list of members, and the number of the button which is issued corresponds with the number of the member on the list. Unfortunately, when I took this matter up with the printer, he misunderstood me, and the programs were all printed with covers. I only intended to have covers on the programs for the members, and then have a certain number struck off without covers to be given out promiscuously.

MR. HERBERT OSBORN: I would like to make a motion that the secretary send our greetings to Miss Murtfelt. She is very much interested in entomology, and I know she watches the work of this Association very carefully.

SECRETARY BURGESS: I would like to second that motion. I had the pleasure of visiting Miss Murtfelt, and passed a very pleasant afternoon in her home, and since that time, owing to the fact that I have been secretary, I have had a number of letters from her. She is deeply interested in entomology, and if this meeting had been held here in the summer I am very sure she would have attended. Motion carried.

PRESIDENT SANDERSON: It has been planned that we hold a session at the Agricultural College on Thursday, and inasmuch as that is perhaps as good an opportunity as we shall have to see the college and the equipment of the state entomologist there, perhaps it would be well for us to accept the invitation tendered us.

A MEMBER: I move that when we adjourn this afternoon that it be to meet at the Agricultural College. Carried.

SECRETARY BURGESS: I would like to ask one question about the program. We have a very full program, and a good many papers have been sent in by parties unable to be present. There are also a few papers, which are not on the program. I think it ought to be arranged in some way so that we shall know just what ones are going to be presented.

A MEMBER: I move that the papers whose authors are not present be moved to the end of the program. Carried.

MR. HEADLEE: It has been suggested that it would be highly desirable for the Horticultural Inspectors to become directly affiliated with this Association, and that, to that end, a committee of this Association be appointed to confer with the committee on organization of the Association of Horticultural Inspectors.

A MEMBER: I move that such a committee be appointed. Carried.

MR. WASHBURN: I should like to ask if anything definite was done at the Washington meeting in this connection.

MR. SYMONS: I would say that the report of the Washington meeting was similar to the one presented by Professor Bruner.

Mr. Summers: In general I am in favor of affiliation where possible, but it seems as though all the affiliation necessary in the case of these societies is merely to avoid conflict. The Association of Horticultural Inspectors cannot combine with this Association because its members are not made by the election of the association, and I do not see any need of affiliation.

Mr. J. B. Smith: There is one other point to be taken into consideration in this connection: Matters which were of particular interest to the Horticultural Inspectors were brought into our meeting and there was so much discussion that it took up too much time. Now, that will bring all that back into the Association again, and I do not know as we want it here at the present time.

President Sanderson: I might suggest, and I suppose that is the reason this matter was brought up at this time, that if there are some who favor this idea, a committee might consider this and take it up at the last session. I do not understand that it would affect our program at all.

Mr. Howard: It seems to me we are wasting valuable time. This matter can be taken up later.

President Sanderson: Is there any further business? I have appointed the following committees:

Resolutions: Messrs. Headlee, Sanders and Symons.
Nominations: Messrs. Osborn, Bruner and Gossard.
Memorial Resolutions: Messrs. Osborn and Davis.
Auditing: Messrs. O'Kane and Cotton.
Affiliation of Horticultural Inspectors: Messrs. Symons, Headlee and J. B. Smith.

President Sanderson announced that as Messrs. Quaintance and Forbes of the Membership Committee were not present at the meeting, he would appoint Messrs. J. B. Smith and Burgess to serve in their places.

In accordance with a previous arrangement the final business of the meeting was transacted at the session Wednesday afternoon, December 29.

President Sanderson: The first thing on the program is a report of the Committee on Legislation by Professor Symons.

Mr. Symons: I have no formal report to make, but will say that during the past year the committee has aimed to do everything in its power to forward the passage of the so-called Simmons bill, which has been before Congress. We were invited to appear before the Agricultural Committee last January and present our claims as to the worthiness of this bill. It seemed that the orchardists of West Virginia and other places had previously taken the matter up with the Secretary of Agriculture, and were also anxious to be heard, and it appeared that

the nurserymen likewise were there, and the rank and file of the importers of stock were present at the hearing. It developed that the nurserymen opposed the bill, particularly one section of it which gave power to the Secretary of Agriculture to quarantine against any infested section in Europe. Hearings were given these parties, but on account of the rush of business in Congress, it being toward the end of the session, the bill was not brought to a vote. I have learned that toward the close of the session an agreement was made to cut out the objectionable section—Section 8—and it was thought the measure would go through, but there seems to have been some hitch in the matter even after that, so it was promised that this bill will be taken up immediately after the holidays. As far as I know this section has not been taken out of the bill, and I would simply recommend to the Association that a committee be appointed to take up the matter energetically, as it seems the time has arrived when we should act irrespective of the nurserymen, but not necessarily be antagonistic to them, that is to say, invite their support, but at all odds, push the matter with every means at our command. I think there is a big opportunity for this Association to make a name for itself in securing this legislation.

Secretary Burgess: I move the report of the committee be accepted and a committee be appointed by the chair, as suggested in the report just submitted. Carried.

Mr. J. B. Smith: I want to add just a word to what Mr. Symons has said. I was present at that hearing, and the impression that was left upon me at that time was that the nurserymen did not want a bill. They took the ground that they objected to it on account of the quarantine section, but after the department yielded to them and was ready to take out the quarantine section they began looking for other features to criticise, and I have not the slightest doubt they did not want any bill at all. I think we might just as well go ahead and look after our own interests, and let the nurserymen look out for themselves, and I would suggest that we indorse the bill as a whole, including the quarantine section. The reason is that while we as entomologists can look after our end of the problem, the matter is decidedly serious from the point of view of the plant pathologist. There are a number of plant diseases that cannot be recognized at the time of importation. Take the white pine blister rust, for instance, and other diseases which are absolutely impossible of recognition in early stages, and the only protection we have against their introduction is a rigid quarantine in sections of Europe or other countries where the disease is known, and without section 8 the bill is useless.

Mr. Symons: I neglected to mention the great help that both

Doctor Smith and Professor Worsham gave us in presenting the entomological aspects of the case before the Agricultural Committee. In fact, I would say that Doctor Smith made a very favorable impression upon the committee.

President Sanderson: As I understand it, the report of the committee made by Mr. Symons indorses the Simmons bill. I want to make that matter clear—as I understand it, the Bureau of Entomology has an understanding with the nurserymen that they will accede to the withdrawal of this section.

Mr. J. B. Smith: There is no understanding between the Department of Agriculture and the nurserymen as to that point. The department is pushing the bill with all sections intact.

President Sanderson: I want to make that matter perfectly clear and have the Association vote on it, because if we instruct the committee to push the matter as it now stands, our committee would feel some hesitancy unless they had a full understanding, and I hope the Association fully understands that part of it, and will vote advisedly upon it.

Mr. Symons: I would like to see the Association give the matter thorough consideration. Personally, I would rather see a bill without that section than to see no bill at all, but if the Association feels it must stand for that section, irrespective of consequences, I would agree to it. The question is whether the Association would not rather see a bill without that section than to see no bill at all. I believe from an entomological standpoint at least, that it will make a start toward good legislation.

Mr. S. J. Hunter: If my memory serves me right, at our meeting in Boston, an arrangement was finally decided upon.

President Sanderson: That was in the Association of Horticultural Inspectors, was it not?

Mr. S. J. Hunter: Yes, the Horticultural Inspectors. They received from the committee of the National Nurserymen's Association a protest against what we thought was in conformity with their wishes, and what we thought they agreed to.

President Sanderson: I might make a suggestion for the consideration of the Association, and that is, that I believe this Association could afford to allow this committee a small amount of money for the purpose of carrying on necessary correspondence during the next month in getting the horticulturists at work, and rousing public sentiment in this matter. I have an idea that $25 would cover postage and necessary expenses of the work.

Mr. Symons: Would this Association be willing to instruct the committee to use its discretion in securing the passage of the Simmons bill?

MR. HERBERT OSBORN: I move that the Committee on Legislation be authorized to use its discretion in the matter of securing legislation, agreeing as closely as possible with the Simmons bill. Motion carried.

PRESIDENT SANDERSON: I will appoint on that committee Messrs. Symons, Worsham and J. B. Smith.

SECRETARY BURGESS: I think the president has mentioned the matter of allowing a small amount of expense money for postage, etc., and it seems to me if that matter is to be taken up at all it should be settled at this time.

MR. HEADLEE: I desire to move that a sum of $25, or such part thereof as is necessary, be appropriated from the treasury of this Association to be used for the purpose just mentioned. Motion carried.

PRESIDENT SANDERSON: We will now take up the report of the Committee on Resolutions.

REPORT OF COMMITTEE ON RESOLUTIONS

Ladies and Gentlemen of the American Association of Economic Entomologists:

Your committee desires to present the following report:

WHEREAS, There now exists a great lack of properly trained men for the work in economic entomology in the country at large, be it

Resolved, By the Association, that universities and agricultural colleges within whose province it naturally falls to supply this need, be urged to provide adequate facilities for the thorough training of capable men for the profession of economic entomology.

WHEREAS, The recent importation of brown-tail and gypsy moths on nursery stock from abroad has most forcibly demonstrated the imperative need of an adequate national inspection law, and whereas, the Simmons bill now before Congress proposes a sufficient and satisfactory law, be it

Resolved, That this Association by every means in its power, urge upon Congress the necessity for passing this bill without unnecessary delay or change.

WHEREAS, The University of Minnesota, through Dean Appleby and the Staff of the School of Mines, and through the School of Agriculture, has most courteously provided this Association with highly satisfactory accommodations, be it

Resolved, That the Association's most sincere thanks be extended to the proper authorities.

WHEREAS, It is undoubtedly due primarily to the efforts of Prof. F. L. Washburn that the Association has experienced such delightful treatment during its stay in Minneapolis, both at the University and in the city, be it

Resolved, That the hearty thanks of the Association be extended to him for his very thoughtful and kindly efforts in its behalf.

Respectfully submitted,

T. J. HEADLEE,
THOMAS B. SYMONS,
J. G. SANDERS,
Committee.

Voted that the report be accepted.

President Sanderson: We will next hear the report of the Auditing Committee by Mr. O'Kane.

REPORT OF THE AUDITING COMMITTEE

The committee respectfully reports that it has examined the books of the secretary and has found them correct.

W. C. O'Kane,
E. C. Cotton,
Committee.

President Sanderson: The next report is that of the Committee on Memorial Resolutions, by Professor Osborn.

REPORT OF THE COMMITTEE ON MEMORIAL RESOLUTIONS

In the death of Mr. G. W. Kirkaldy the American Association of Economic Entomologists has lost one of its most brilliant and active members and it is with deep sense of its loss that it now records its admiration of the man and his work.

Mr. Kirkaldy was eminent as a systematist and had contributed largely to the growth of knowledge, especially in the group Hemiptera. Especially in his recent Catalogue of Heteroptera, unfortunately complete for only part of the group, he has placed workers in entomology permanently in his debt. While still young and with prospect of a most useful career for the future, the work he had already accomplished will stand as an enduring testimony of his ability and industry.

In the death of Mr. J. A. West the Association was lost one of its younger and valued members. He was generally recognized as a scientist of exceptional ability and by those who knew him more intimately he was appreciated as a painstaking and energetic worker. His ability was also recognized by the progressive agriculturists in his own and many other states where he was so often called for addresses on entomology.

Resolved, That these resolutions be placed in the published records of this meeting of the Association and that copies be transmitted to the families of the deceased.

Herbert Osborn,
John J. Davis,
Committee.

Voted that the report of the committee be accepted and the recommendations adopted.

President Sanderson: The report of the Committee on Nominations is next in order.

REPORT OF THE COMMITTEE ON NOMINATIONS

Your Committee on Nominations begs leave to submit the following report:

For President, F. L. WASHBURN of Minnesota.

First Vice-President, E. D. BALL of Utah.

Second Vice-President, R. H. PETTIT of Michigan.

Member of Committee on Nomenclature, A. L. QUAINTANCE.

Members of Council, A. A. A. S., { H. E. SUMMERS, E. D. SANDERSON.

Members of Advisory Board, JOURNAL OF ECONOMIC ENTOMOLOGY, L. O. HOWARD, S. A. FORBES.

Respectfully submitted,

HERBERT OSBORN,
LAWRENCE BRUNER,
H. A. GOSSARD,
Committee.

It was moved and seconded that the secretary cast a ballot for the election of the members nominated. The ballot was cast and the members nominated were elected.

PRESIDENT SANDERSON: We will now take up the report of the Committee on Membership.

REPORT OF THE COMMITTEE ON MEMBERSHIP

The Committee on Membership begs leave to submit the following report:

For foreign membership:

Dr. L. P DeBussy, Biologist of the Tobacco Growers' Association, Deli, Sumatra.

Mr. N. Kourdumoff, Opytnoe Pole, Poltava, Russia.

For advancement from associate to active membership:

Back, E. A., Blacksburg, Va.
Barber, H. S., Washington, D. C.
Foster, S. W., Washington, D. C.
Gahan, A. B., College Park, Md.
Johannsen, O. A., Orono, Me.
Jones, P. R., Washington, D. C.
Kelly, E. O. G., Washington, D. C.
O'Kane, W. C., Durham, N. H.

For associate membership:

Babcock, C. G., College Park, Md.
Cory, E. N., College Park, Md.
Criddle, Norman, Treesbank, Manitoba, Can.
Culver, J. J., Melrose Highlands, Mass.
Douglass, B. W., Indianapolis, Ind.
Gill, J. B., Washington, D. C.
Hartzell, F. Z., Geneva, N. Y.
Hoff, E. P., Logan, Utah.
Holloway, T. E., Brownsville, Tex.
McGregor, E. A., Dallas, Tex.

Oestlund, O. W., Minneapolis, Minn.
Osborn, H. T., Wellington, Kan.
Pinkus, Harry, Dallas, Tex.
Tothill, J. D., Melrose Highlands, Mass.
Winslow, R. M., Victoria, British Columbia, Can.
Wolcott, G. N., Dallas, Tex.

Two active and two associate members are in arrears for dues for three years. It is recommended that the secretary notify them of their delinquency, and if in three months thereafter the dues have not been paid, that they be dropped from the roll.

Charles W. Hargitt and C. V. Piper have voluntarily withdrawn during the past year.

Respectfully submitted,

H. E. SUMMERS,
J. B. SMITH,
A. F. BURGESS,
Committee.

By vote of the Association the report was accepted and the recommendations adopted.

SECRETARY BURGESS: In regard to the report just presented I would like to say that it would be of advantage to a great many of the younger men in the Association if lists of their publications were filed with the Membership Committee during the year, so that the committee would have an opportunity to go over the lists and know what the members are doing and be able to form a better judgment of their work.

PRESIDENT SANDERSON: We will next hear the report of the committee on affiliation of the Horticultural Inspectors with this Association.

MR. SYMONS: I will simply report that progress has been made looking toward affiliation with the Inspectors, but it will be necessary to consider the matter at the Inspectors' meeting.

PRESIDENT SANDERSON: The report of the committee on the affiliation of the societies interested in agricultural science will be considered.

MR. HEADLEE: Would it be out of place to ask for a statement of the advantages of this affiliation?

PRESIDENT SANDERSON: Can Mr. Bruner inform us what the advantages of affiliation to this Association will be?

MR. BRUNER: I can not, because I can see no advantages.

MR. HERBERT OSBORN: I move that the matter be laid on the table and the committee discharged.

MR. SYMONS: I should like to hear Doctor Smith say a few words on this matter, not that I have any partisan views whatever, but I believe the idea was that affiliation of all these associations would be an advantage to this Association, but from the standpoint of economy, where we have to pay to become a member of this affiliation it does at first sight seem an embarrassment to this Association. Those who at-

tended the meeting of the committee were not in a position to pledge themselves to anything, and this report does not pledge any one, but it did seem to those assembled that it was a move in the right direction, and it was referred back to the Association in the hope that the matter would be discussed. I simply make this statement for I felt then and I feel now that if these associations can do anything toward the promotion of agricultural science we should consider it in a safe and sane way.

Mr. J. B. Smith: In view of the fact that Mr. Symons has brought my name into the matter—I represented the Horticultural Inspectors and took some part in the discussion—I wish to say that one of the strongest advocates for affiliation was the one representative from the Association of Economic Entomologists. The man who made the strongest arguments in favor of affiliation, was the representative from this body, Mr. Hopkins, and he practically drafted the constitution, so the action proposed is a direct rebuke to our representative at this meeting. He presented arguments in favor of affiliation somewhat in this way: The members of the Association of Economic Entomologists are largely in official positions, largely teachers in agricultural institutions, and interested in a general way in the advancement of agricultural science. The body that meets in Washington every other year, which represents all the agricultural colleges and experiment stations, the Association of Agricultural Colleges and Experiment Stations is represented by their presidents and directors. Nevertheless, there are a number of other associations that meet at the same time in connection with them, and it would seem to be good policy for all bodies that are in any way connected with agricultural colleges and experiment stations to meet at least once in two years together. There was no suggestion that the autonomy of the Association or Society should be interfered with. It was deemed wise, in order to retain the connection between these bodies, to have a meeting once in two years, and that the meetings should always be held in Washington; that one year we should meet in Washington, and the other year anywhere we chose. Assuming that that would be the idea, it would seem to be suggested and to be believed by those who favor affiliation, that it would cheapen the matter to all the societies if that could be done, and would bring harmony into the general methods of work. Of course, the underlying idea was that there might be a publication on agriculture that would cover the entire field, with the understanding that it might be divided into different sections. Personally, I would say I am not in favor of affiliation. I am simply presenting now to this Association, which I did not represent, the argument which your representative presented with all his power and with all the effect he possibly could.

In fact Doctor Hopkins and Doctor Allen of the department really drew up this proposed constitution as it stands at the present time. My own position I think was entirely clear in this matter. I think it is only fair that before the Association takes definite action in voting for the motion as it stands, that it should know the Association is responsible.

Mr. Symons: I wish to say that I believe, in fairness to Doctor Hopkins, that he was acting in his official capacity, and that he was carrying out, as he thought, the wishes of this Association.

Secretary Burgess: Professor Bruner, Doctor Hopkins and myself were members of the committee, continued over from the time that the first work was done on affiliation. Professor Bruner and myself were unable to be present at the meeting in Washington last fall. Doctor Hopkins, of course, was at Washington, and did all the active work. Personally I had no knowledge of what the committee had done until the report was made yesterday, and I might say also that it seems to me that there are serious faults in the agreement, which would render it difficult for this Association to comply with at the present time.

Mr. Herbert Osborn: It seems to me that as the matter stands, we could not take any favorable action, and that the question ought to be laid on the table. I am perfectly willing the committee should be continued if there is anything that could be accomplished by its retention.

President Sanderson: It seems to me if that report could be accepted it would be at least a more courteous way of handling the situation, and I think the members of that committee who are here are sufficiently familiar with the situation, without any further discussion, to enable them to take the matter up. I would say I believe there is very strong sentiment in favor of this affiliation, and personally, I believe this Association cannot afford to divorce itself from the Agricultural associations of the country. If this thing is going through, and our representative has taken such an active part, we ought not to turn him down. I certainly would like to have this report placed on file with the understanding that we recognize the objections.

Secretary Burgess: I think there is one clause in this resolution and agreement which bears on the matter. After enumerating the different societies which are supposed to enter into the agreement, representatives of which have signed the agreement, it states that it is subject to ratification at the first session held by the societies mentioned subsequent to this date. If we accept this report it seems to me we indorse the agreement.

President Sanderson: I mean that we accept it simply as placing it on file.

Mr. Symons: I move that the report of the committee be received and the committee continued.

President Sanderson: The substitute motion that the report be received and the committee continued is carried.

We have also the report of the Executive Committee, which was laid over until this time. What is your pleasure? It might be in order for me to refresh your minds as to the suggestions of the committee. First, to adopt the policy of paying the expenses of the secretary, second to have a standing committee on entomological investigations, as suggested by the paper of Doctor Headlee, and third that the incoming executive committee submit an amendment that the dues be raised $1 to include the Journal, with the understanding that the Secretary of this Association be made business manager of the publishing association in order to give the secretary as much remuneration as possible.

Mr. J. B. Smith: I move the first recommendation be adopted. Carried.

President Sanderson: The second point is on the matter of a committee on entomological investigations.

Mr. Symons: I move that the second recommendation be adopted.

Mr. Headlee: This committee, to do its best work, ought to be representative of different sections of the country, and I doubt whether three persons is a sufficient number to make a representative committee. I think we ought to adopt this.

Mr. Washburn: What are the duties of this committee? Why do we need such a big committee? I should suppose a very small committee would do.

Mr. Headlee: The reason I suggest a larger committee is this: The problems in the different sections of the country vary greatly. The Southern problems are very different from the Northern, and the Western are very different in many respects from the Eastern. If we do not have a committee representing these different sections of the country, we are not going to get as good discussions of the projects under way; we are not going to get as helpful statements in pointing out the desirable and undesirable features and possibilities of change for the better. For instance, say a committee member lives in Texas, where problems are exceedingly different from problems in Minnesota—that man, owing to his familiarity with conditions in the South, ought to be able to modify the discussions submitted by the committee as a whole on southern problems in a very desirable manner. I do not see that there would be any difficulty in coming to an agreement among the members of the committee. The information could be collected and the discussions written by one member, and then sent around to the other members, and they could revise and change as they saw fit, and then return to the man who did the first writing.

Mr. Washburn: I must confess ignorance as to just what the duties of that committee are.

Mr. Headlee: I feel considerable hesitation in trying to answer the question. The first duty would be to gather information in regard to projects now under way. The second would be to draw these projects together and formulate them into some sort of table, possibly, that could be published in the Journal, and form a basis for discussion at the regular meeting. The third duty would be to write a broad-gauged discussion of the general tendencies which these investigations showed.

President Sanderson: It is suggested that the com[illegible] be of three members.

Mr. Symons: Make it five.

President Sanderson: I would say, that as contemplated originally by the Executive Committee, this proposition did not include the Bureau of Entomology. Through a misunderstanding this year, and through loss of a letter which was written by me to the bureau, we failed to have the coöperation which we feel certain we will have in the future. The proposition was that the Bureau be invited to have a representative to give an outline of the work of the Bureau exactly as this committee would secure from the different states. Motion is carried.

President Sanderson: I will ask the Nominating Committee to nominate that committee as a standing committee, if they can do so, before we adjourn this afternoon. The third proposition is regarding the amendment to make the dues include the Journal. This is brought up merely for discussion at this time, so that it may take the sense of the meeting.

Mr. Symons: In order to bring the matter before the house I move that this provision be adopted, and if I can have a second, I should like to discuss it for a moment. (Motion seconded.) I would simply say I have been opposed to joining the dues and the Journal for the reason that I did not think it would be best to make it necessary for the young men joining the Association to take the Journal. I have learned, however, that there are only about twenty members of the Association who have not taken the Journal, and it is safe to say they could all afford to take it, therefore, I take pleasure in making the motion to include the dues. It would certainly greatly simplify the work of the secretary.

President Sanderson: If I may suggest; this is simply giving us a year to consider the question, and with seventy-five members present next year, they might consider it very differently. Motion was carried.

The secretary suggests that the Association may wish to take some action looking toward the matter of program for the coming year, as to how much time you wish to take.

MR. WASHBURN: This is merely a thought which occurred to me this morning: It is evident that if we can have only two days we are always going to be crowded. If we could abstract the papers, and the readers of the papers simply give results, in case there are results, and then have a few symposia, perhaps we would get over more ground than if we had the reading of all the papers in detail.

MR. COTTON: It seems to me one way we can get around this matter is to leave it to the Program Committee next year, if a large number of papers are coming in, to extend the time one day, if necessary, or to make some provision for night sessions, or it might be possible to have a joint meeting with the Entomological Society of America or the Horticultural Inspectors, and not encroach upon either one, and to that end I make a motion that the secretary be authorized to use his discretion in that matter.

PRESIDENT SANDERSON: It is moved and seconded that the matter be left to the discretion of the secretary as to the length of time occupied by our program.

SECRETARY BURGESS: Mr. President, I have always endeavored in the matter of the program to try to arrange it in such a way as to be satisfactory, fitting in with the time of the other societies that meet at the same time, and I think that policy should be continued in order that we may work in harmony with the other societies that want to meet the same week. In regard to papers, it is a very difficult matter to lay down any hard and fast rules as to what you will or won't take, and I do not think it should be the policy of this Association to discourage the sending or presentation of papers. It seems to me that if a man belongs to the Association, according to the constitution he has an equal right with any other member to present papers, or enter into discussion, and I do not think we should try to curtail that any more than is absolutely necessary, and I feel that under the motion just made we can probably make satisfactory arrangements for next year.

PRESIDENT SANDERSON: You have heard the motion that the matter be left to the secretary. What is your pleasure? Motion carried.

MR. O'KANE: There is a matter which I wish to present at this time. There are a good many of us who live a long distance from any place of meeting that may be chosen, and traveling expenses are a burden. I am advised that two years ago the Committee on Station Policy took this matter up, but did nothing about it. I should like to see the Association take some action by which the incoming Executive Committee

could take this matter up and urge the advisability of paying the expenses of entomologists to these meetings.

It was moved and seconded that the Executive Committee take the matter up with the Committee on Organization of the Association of Agricultural Colleges and Experiment Stations. Motion carried.

A Member: I should like to say in this connection that if we were more closely affiliated with the Association of Agricultural Colleges and Experiment Stations it would be easier to get the expenses paid than when the entomologists hold themselves aloof.

President Sanderson: I would say that the meeting of the Journal Publishing Company will be held this evening at 7.15 at Hotel Dyckman. The election of officers has already taken place under the report of the Committee on Nominations.

On motion, the President appointed a committee consisting of Messrs. Washburn, Herbert Osborn and Burgess to take up with a similar committee of the Entomological Society of America the matter of securing positions for entomologists.

Mr. Symons: I move that the time and place of the next meeting be left to the Executive Committee.

President Sanderson: That finishes the business. The Committee on Nominations has selected the following standing committee on Entomological Investigations: Messrs. Sanderson, Headlee, Titus, Sherman and Britton.

PART II

President Sanderson: Unfortunately neither of our vice-presidents are present at the meeting, therefore I will ask Professor Summers to take the chair.

Chairman Summers: We will now listen to the annual address of the president.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

In accordance with the constitution the following committee on membership has been appointed for the year 1911: Dr. John B. Smith, Chairman, Dr. E. P. Felt and Prof. Herbert Osborn.

F. L. Washburn, *President.*

THE WORK OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

By E. DWIGHT SANDERSON, *Morgantown, W. Va.*

Your president sincerely appreciates the honor conferred upon him in electing him to preside at this, the twenty-third annual meeting of this great association of economic entomologists. He has also had occasion to realize that with this is imposed the duty required by our constitution of presenting an address. In again perusing the scholarly addresses of the former presidents of this association I soon became aware that I had not been chosen for this task from any consideration of the possibility of my maintaining the high standard set by my illustrious predecessors as far as any exposition of entomological knowledge might be concerned. (And may I remark in passing that no entomologist should consider his entomological education complete until he has read the addresses of the former presidents of this association and glanced over the business and programmes of its meetings, for they contain the richest digest of American economic entomology, and will unfold to him the heritage to which he has attained.) I was forced to the conviction that the only reason for my designation for this part must lie in the fact that I have been an ardent believer in the usefulness of this association and have done the best I could to promote its organization and usefulness. If this supposition be true, I may, perhaps, be pardoned for venturing upon a consideration of the work of this association, its sphere, and its future. In doing so I am reminded that ten years ago, at the first meeting of this association which I was able to attend, Vice-President Gillette gave an address on the "Objects of the Association of Economic Entomologists," in which he ably discussed much of the same ground which I shall again present for your consideration. It would seem that some of these fundamental matters are of perennial interest and must needs be discussed and reconsidered with the passing of every decade.

THE OBJECTS OF THE ASSOCIATION

Article 1, Section 2 of our constitution very clearly defines the objects of this association, as follows:

"Its objects shall be: (1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work in economic entomology; (2) to give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions

and avoid unnecessary duplication of work; (3) to suggest, when possible, certain lines of investigation upon subjects of general interest; (4) to promote the study and advance the science of economic entomology." It behooves us, therefore, to occasionally consider whether this organization is developing along the lines laid down in the constitution by its founders, and more recently ratified by us, and how it may be further strengthened and developed.

The first two or three of these objects seem to have been most prominent in the minds of its founders and have been the directing force in its development. In recent years, however, there has been a marked tendency to make the association more of a working organization and to devote attention to the development of the science of economic entomology and its application to public welfare, under the fourth object above, which may be likened to the "general welfare" clause of our federal constitution. With the rapid increase in membership, this tendency must be inevitable, and I shall endeavor to discuss the work of the association under the above heads and to venture some suggestions for its further development.

THE DISCUSSION OF NEW DISCOVERIES

A. *The discussion of new discoveries.*—In 1889 with 22 charter members it was possible for the association to discuss the discoveries of each member who wished to present them, and this was practically so up to 1900 when we had 109 members; but with the 264 members now enrolled, and with every prospect of a steady growth, it is evident that there must be some selection of what "new discoveries" are most worthy of our joint consideration. That some systematic presentation of the advances made in the previous year would be a most useful feature of our meetings can hardly be gainsaid, for with the wide range of investigation now being carried on by a host of workers, it is beyond the power of most of us to keep even fairly well informed concerning even the more important work being done. In his presidential address before the seventeenth annual meeting, Mr. Quaintance made a suggestion[1] which I have always regretted was not more favorably considered and I beg to again call it to your attention. It was "that a person be annually designated for each of the principal natural divisions of the general subject whose duty it will be to present, at the following meeting, a *résumé* of the principal results achieved in that particular branch during the year. The reports of these several persons would become part of our proceedings and could be referred to at will by workers in other lines." A list of such branches of the subject was given which is now generally recognized as a

[1]Bulletin 52, Bureau of Entomology, p. 17.

useful classification. I am sure that the annual *résumé* of insect injuries published by the Bureau of Entomology in the Yearbook of the Department of Agriculture has been most useful as a matter of reference, and I believe that a *résumé* as suggested by Mr. Quaintance would soon be found a most valuable feature of our work. It may be questioned whether such reports would not unduly tax our annual programme, but might it not be possible to have the reports published in the October number of our JOURNAL, and the consideration of those which seem most important might then be arranged for by a programme committee?

THE EXCHANGE OF EXPERIENCE

B. *To exchange experiences.*—This is one of the most valuable features of our annual gatherings of which we do not always secure the largest benefit. Such an exchange may be secured through symposiums upon topics of general interest, by discussion of papers read, and by personal conferences. The latter will be further discussed under item 2. The discussion of papers is becoming more and more limited by the fulness of our programmes. For several years we have advocated the expediency of having one or two symposiums upon topics of general interest, as has become quite common in other organizations of this nature, and various attempts to this end have been made. The committee on resolutions reported at our last meeting in favor of the secretary attempting to arrange such symposiums for this meeting, which was adopted, and your secretary has endeavored to do so. A program committee might be valuable in shaping our programs and ensuring a continuity of policy thereof, and I would suggest the feasibility of a standing program committee to be composed of the secretary and two members, each to serve three years in rotation.

CONSIDERATIONS OF METHODS OF WORK

C. *To carefully consider the best methods of work in economic entomology.*—There has been a marked tendency in our meetings to devote more attention to methods, from which I feel sure we have all derived great benefit. It must be apparent that in attacking new problems we often expend too much time and money in developing methods which later we often find have been worked out by others, unknown to us. There is great need for a compilation concerning methods and apparatus used in investigation in economic entomology. The late Professor Slingerland was engaged upon the compilation of such data for the use of his graduate students, and it is to be regretted that he was not spared to complete a task for which he was so eminently quali-

fied, and it is to be hoped that some one may complete the labor and give us the results in some accessible published form.

ANNOUNCING PROPOSED INVESTIGATIONS

2. "To give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and avoid unnecessary duplication of work." This topic opens a broad field for the discussion of various matters which have been of interest to this association since its organization. In general we have had but few such outlines of proposed investigations, though there has been a hopeful tendency to make use of this feature of our meetings in late years. It must be evident, nevertheless, that with our present membership it would be impossible for all to avail themselves of this privilege. It must be equally evident to every thoughtful worker that there has been and is an enormous waste of time and money in our investigations through a lack of reasonable coöperation. I would not urge an avoidance of all duplication, or even an attempt to always secure uniformity of method, though that is desirable as far as possible; but is there any reason why several workers who are attacking the same problem in different fields should not confer together in person or by correspondence concerning the problem in hand, the methods and results, so as to be of mutual help? There is a tendency on the part of some to decline such publicity of their plans for fear that some one else will proceed to make use of them, or that some one will appropriate their results. I suppose that entomologists are as prone to the failings of human nature as any other set of men, and that the honest and generous must always suffer from those whose consciences seem somewhat dull in this regard, but I ask in all sincerity, are we to base our relations to each other on the assumption that all our colleagues, or even any considerable number, will not treat our confidence with all the consideration that we ourselves give and expect? If so, I fear we need a revival of entomological ideals. Fortunately, such is not the case. No man who is doing work worthy of recognition need ever fear that his reputation will suffer from that of his imitator, and I always have a lack of sympathy for the man who is constantly fearing that his generosity will be abused. The slogan of the age is "Get together!" and we must remember that we are employed by the people to serve their best interests, and that we must in honor avail ourselves of whatever means will best advance our work to that end and best utilize the expenditure of public moneys.

There has been a considerable advance along this line, and it is now not infrequent for experiment station investigators who are working on the same problem to meet together and carefully consider the

best means of work, its correlation, and uniformity of method so that the results are comparable. Were we informed as to the work our colleagues are doing we might often have such conferences at these meetings, which would be of the greatest value; but unfortunately we often go ahead with a new project in entire ignorance that it is being attacked by another with whom we might readily confer. Then, too, preliminary results, not ready for publication, if exchanged, will often save a large amount of unnecessary work or hasten the progress of investigation.

With these ends in view your executive committee has recommended the establishment of a standing committee to report on the investigations in progress and those contemplated, such a digest to be published in the December number of the JOURNAL, which we will arrange to have issued earlier in the month so that it may be available before our annual meeting. As an example of what such a report might be, Dr. T. J. Headlee has very kindly prepared such a report for this meeting which will furnish some idea as to whether such an undertaking is desirable.

THE IMPORTANCE OF COÖPERATION

This subject of coöperation has engaged the attention of this association at periodical intervals for many years. At its sixth meeting Messrs. Osborn, Smith and Garman, made a carefully considered report on this subject, which, however, seems never to have borne much fruit. With the present organization of entomological work in this country it is evident that any coöperation must be purely voluntary, but that does not necessarily preclude its effective organization. In general we have three classes of workers, those of the state agricultural experiment stations, those of the Bureau of Entomology, and the state entomologists, and we must consider the interrelations of these classes.

COÖPERATION BETWEEN EXPERIMENT STATION ENTOMOLOGISTS

This association had its inception with the organization of the agricultural experiment stations under the Hatch Act in 1888. At its second meeting President Riley in his address discussed some of these problems in a masterly manner. He said,[2] "Every other subject that might be considered on this occasion must be subordinate to the one great question of coöperation. With the large increase of actual workers in our favorite field, distributed all over the country, the necessity for some coöperation and coördination must be apparent

[2]Insect Life, Vol. III, p. 202.

to every one." So it was, and so it always has been; but how little has been accomplished along this line, not only as between the entomologists of the experiment stations, but between all the lines of agricultural investigation. At the time of Dr. Riley's address (1890) it was objected by one member, whom we all know as one of our best workers, that the time had not yet come for such coöperation owing to the pressing demand of immediate, often local, and occasional problems. It would seem that in some respects it is still as far off. With the passage of the Adams Act in 1906 the work of the experiment stations was placed upon a decidedly better basis. Under that act the projects of investigation must be carefully considered, thoroughly outlined and approved by the Department of Agriculture at Washington. Hence there is no reason why workers on similar projects should not arrange for the most feasible sort of coöperation. We may regret that the Office of Experiment Stations has not seen fit, undoubtedly for good reasons, to make known to the different stations what lines of investigation others are contemplating until after they have been well launched, and we might wish that that office might find a means whereby it could aid the sort of coöperation which is evidently feasible. But if that cannot be done, there seems no good reason why the entomologists, at least, may not arrange for coöperative work in any way that may be found practicable.

In the address referred to (*l. c.* p. 203–205), Dr. Riley also called attention to the relation of the experiment stations to the National Department of Agriculture and discussed the matter in a statesmanlike manner. Dr. Riley evidently feared that, as he said, "the old saw to the effect that 'the dog wags the tail because the tail cannot wag the dog' will find another application," referring to the weak condition of the Division of Entomology at that time in relation to the strength which he foresaw that the experiment stations would assume, and the fact that the Hatch Act provided no well-defined, organic relation between the two. But Dr. Riley would have no need for fear had he lived to see the present magnificent organization of our national Bureau of Entomology with its staff of "six hundred and twenty-three individuals, of whom one hundred and thirty-one are trained entomologists"[3]—more than the entire membership of this association ten years ago.

COÖPERATION WITH THE BUREAU OF ENTOMOLOGY

If it is desirable that there be coöperation between station workers, it is equally evident that there should be coöperation between the

[3] L. O. Howard, Science, XXXII, p. 771, Dec. 2, 1910.

Bureau of Entomology and the station and state entomologists, and that there be a well-defined relation between these agencies and a mutual understanding as to their spheres of work. We are glad to note that there has been much more coöperation between the Bureau of Entomology and the station and state entomologists than between the latter, and there seems to be a decided tendency toward a satisfactory working out of the many difficult problems, often complicated by local conditions, which this subject involves. On the other hand, we cannot but feel that a better understanding of the work of the Bureau as it is in progress, would be of distinct advantage to all parties and would conduce to more effective coöperation. At present the only general statement of the work of the Bureau to which entomologists have access is in the annual Executive Report of the Secretary of Agriculture. Unfortunately this deals with the work of the previous fiscal year, and has but little to say of the work then in progress or contemplated. These matters are mentioned so that if there be any feasible means, we may be kept better informed of each other's work, so that there will be a constant tendency toward more coöperation and a stronger professional unity.

THE RELATION OF NATIONAL AND STATE AGENCIES IN AGRICULTURAL INVESTIGATION

This whole question of the relation of national and state governmental agencies is an exceedingly difficult one, as many of our foremost statesmen are discovering, and is fundamentally the same, whether in entomological work or the control of corporations. It has had the consideration of some of our most thoughtful leaders both in affairs of government and in affairs of science. I would commend to you Dr. Riley's discussion above mentioned. More recently the American Association of Agricultural Colleges and Experiment Stations appointed a Commission on Agricultural Research, composed of two men eminent in agricultural research, two eminent scientists not connected with agricultural research, and one representative of the U. S. Department of Agriculture, which reported at the meeting at Washington, November, 1908. The commission was composed of David Starr Jordan, Carroll Davidson Wright, Henry Prentiss Armsby, Whitman Howard Jordan, and Gifford Pinchot, whose names are a sufficient guarantee of the depth and breadth of the consideration given the subject, but after some discussion it seems to have had no practical outcome. The whole report should be read, but I beg your indulgence for one or two quotations, which seem to digest this whole question in an admirable manner.

"C. As has been pointed out, there is an extensive overlapping of the fields of effort of the United States Department of Agriculture and of the Agricultural Experiment Stations. It is evident that such a situation cannot wisely be allowed to continue. So far as possible the functions and fields of operation of these agencies should be clearly outlined. This is essential to definiteness of aim, freedom of opportunity and the encouragement of the investigator. Moreover, when two or more public agencies are working toward the same general end, their efforts should be in well-considered adjustment, this being a requisite for economy and efficiency of effort."

"The relation that the national department and an experiment station as research agencies should sustain to each other and to the agriculture of the nation and of a given state is one that relates to a wise public policy rather than to scientific prerogatives. The real question is, how can public funds be distributed to render the greatest possible service in the aggregate; not merely in the promotion of material prosperity but especially in developing the ability of localities and individuals to deal intelligently with their own problems? This question touches a principle which underlies our federal system the observance of which is necessary to preserve the efficiency and method of our democratic institutions. The principle is this: 'Questions which concern primarily and chiefly the people of the locality are to be left to the determination of the locality: questions which concern primarily and chiefly the people of the nation are to be left to the determination of the nation.'"

And further on they conclude: "The interstate or national character of a problem, however, increases rather than diminishes its local importance, while the local application may be after all the main end to be attained by the solution of a national problem. It seems evident, then, that certain classes of problems should be handled by national and state authorities acting jointly. The extent and method of this coöperation must necessarily vary with circumstances. When a national agency takes hold of such questions, it needs to avail itself of the experience and knowledge of local conditions possessed by local agencies, and, therefore, will wisely work through these agencies as far as possible, supplementing them where necessary, but employing its own agents directly only where the local agents are insufficient. At present, effective means of the correlation of national and state agencies is lacking, and the want of it is a serious hindrance to the progress of agricultural research. As a means to that end we recommend the formation of a permanent board made up of representatives from institutions receiving federal or jointly federal and state aid. This board should meet frequently to discuss the mutual relations of

the different institutions and agencies, defining from time to time the principles that should govern each. The influence of such a board if properly organized might be considerable. It may be comparable with that of the Board of State Governors, recently in session in Washington."

To some phases of this report Mr. Gifford Pinchot dissented and presented a separate memorandum, a paragraph of which may be quoted in this connection.

"It is the clear duty of the state agricultural colleges and experiment stations on the one hand, and of the United States Department of Agriculture on the other, to lay aside their differences, if they have any, and to work unitedly for the common good of all the people. There is far more work to be done than all available means can possibly accomplish. Agricultural research does not need to wait on opportunity, for opportunity is already here in overwhelming measure. To meet the huge demand in this field requires united effort. To be effective, united effort must be organized. Instead of the unconvinced and unconvincing suggestion for an advisory board contained in the report, I desire for my own part to substitute the statement that the fundamental need of agricultural research in the United States is a thoroughgoing coöperation between the state and national agencies, under a definite but not a rigid plan. In my judgment such coöperation can be best reached, and the necessary plan can best be prepared and modified, through the agency of a coöperation board or similar body representing both state and nation, created on the assumption that state and national agencies are simply parts of one great instrument which exists for the general good, and organized to give that view effect. Such a board should be required to make suggestions for the coördination and advancement of agriculture and agricultural research in the states and nation but it should be without, wholly and altogether, direct authority beyond what might be inherent in the value of the methods and work it would suggest. It should give no orders."

Although these recommendations differ somewhat in detail the essential objects are the same, and evidence the general appreciation of the need of more coöperation in research work. That such coöperation is not so easily arranged at present as it might have been twenty years ago is at once apparent when it is remembered that some of our agricultural experiment stations are almost wholly dependent upon federal appropriations, while in other states the funds received from the national government comprise but a minor part of the total income of the station. Obviously any plan of coöperation must be voluntary, if it is to succeed in a broad way.

The relations of the state entomologists to the state experiment stations is usually a matter dependent upon local circumstances, but

their relation to the National Bureau of Entomology is much the same as that of the station entomologists.

POSSIBLE COÖPERATION DEMANDS CONSIDERATION

I have discussed this matter of coöperation somewhat at length in order to again bring to your attention the serious consideration that has been given it by some of our most eminent and respected workers in agricultural research. I am not prepared to offer any suggestions as to just how better coöperation may be brought about, except through a greater publicity of the work undertaken and proposed, but I do most earnestly commend the whole problem to the careful consideration of this association. The official agricultural chemists have done most efficient coöperative work in a large way. May not the official entomologists profit by their experience as modified to meet their own needs?

3. "To suggest when possible certain lines of investigation upon subjects of general interest." This has been done at various times by individuals and committees of this association. Were a committee to report on the entomological work of the year, as suggested above, they might very readily make such suggestions from time to time as a result of their survey of the lines of work which seem most promising or are not receiving sufficient attention.

4. "To promote the study and advance the science of entomology." As before suggested, this may be considered the "general welfare" clause of our constitution under which we may proceed to do whatever seems best for advancing the science of economic entomology.

THE TEACHING OF ECONOMIC ENTOMOLOGY

First let me call your attention to the phrase "to promote the study." I fear that we have somewhat neglected this phase of our entomological work, both in our annual programs and in our published papers. For some time I have had a desire to know how entomology, and particularly economic entomology, is being taught in our colleges and universities, and I have had the feeling that most of us had very much to learn along that line. I fear that we have given vastly more attention to our investigations than to our teaching, usually due to circumstances beyond our control, and that many times our students have finished a course with more of a general smattering than a concrete and practical knowledge of insect life and the control of agricultural pests. A symposium upon this subject has been arranged for this meeting, and may we not have more consideration of the subject matter and methods of instruction in economic entomology.

Our constitution specifically provides for the admission of teachers as members, and in the future we will see more of a separation of the function of teaching and investigation, as is now taking place in all lines of agricultural instruction and research.

THE DUTY OF THE ASSOCIATION TO THE PUBLIC

As with all national organizations of a public character, as this association has grown in membership and as it will grow in the future, its responsibilities to the public increase, and if it is to receive the general support necessary for its successful maintenance it must not only maintain an annual meeting for the presentation of papers and the discussion of the problems of the profession, but it must exercise its influence in all legitimate ways toward conserving the best interests of our people as they may be affected by insect life. In recent years this association has had an increasing influence in encouraging needed legislation and in educating the general public upon matters entomological which are of general concern. At the present time one committee is aiding in securing the passage of a national law for the inspection of importations for insect pests. This committee should be given the most loyal support in any way which may lie within our power, for it is almost a reflection on American entomologists that they have for so long allowed so important a matter to be neglected, particularly in view of the many insect plagues which have visited our shores from foreign countries. In such matters a committee of this association should have the same authority and prestige as a representative committee of the Official Agricultural Chemists or of the American Medical Association as related to matters concerning those professions. I fear such is not the case. If not, the fault is not with Congress, nor with the public. The influence of this association is and will be what its members make it, which in the last analysis will depend upon their own estimate of their usefulness and duty to the state. Underlying the success of this organization, as with all professional associations, lies the pride of the man in his profession and his belief in its usefulness to mankind. With a true appreciation upon the part of each member of his opportunity in promoting the public weal, of both his privileges and his duties, we cannot but have an association truly national in scope and influence, and in which we all may well be proud to be enrolled.

OUR PAST ACHIEVEMENTS AND FUTURE OPPORTUNITIES

The problems which present themselves to us for solution seem difficult and sometimes almost impossible, but when we look back over

the past twenty years and consider the marvelous work which the members of this association have accomplished for the American farmer, often under the most unfavorable and discouraging conditions, we may well take heart and resolve to maintain this standard of achievement. But we must remember that

"New occasions teach new duties;
Time makes ancient good uncouth;
They must upward still, and onward,
Who would keep abreast of truth."—*Lowell.*

And so in the affairs of this association. Now and then we need to take our bearings and make sure that we have not drifted from the true course, and again before venturing on new voyages we should first test our compasses and make sure that they are correct and that we may safely follow them. To such observations it has been my privilege to invite your attention this morning, and if it may lead to a fuller appreciation of the real sphere of this association and the great work which lies before it, I shall feel that I have been well repaid for venturing to present these thoughts for your consideration.

President Sanderson: We will proceed with the program as arranged by the secretary. I would like to ask before we start on the program what is the pleasure of the association as to the time to be allowed for the reading and discussion of papers. There seems to be no time allowed on the program for discussion.

A Member: I move that the time of presenting papers be limited to fifteen minutes, and not more than five minutes be allowed any member for discussion. Carried.

President Sanderson: The first number on the program is "Economic Entomological Investigations now Under Way," by T. J. Headlee, Manhattan, Kan.

A BRIEF REPORT ON THE WORK NOW BEING PROSECUTED BY SOME ECONOMIC ENTOMOLOGISTS IN THE STATE UNIVERSITIES, AGRICULTURAL COLLEGES, AND EXPERIMENT STATIONS OF THE UNITED STATES

By T. J. HEADLEE, PH.D., *Professor of Entomology and Zoölogy in the Agricultural College, and Entomologist and Zoölogist of the Experiment Station of Kansas*

INTRODUCTION

The following suggestion was presented to the executive committee of the American Association of Economic Entomologists by Mr. E. D. Sanderson.

"It has seemed to me that entomological workers are wasting time and effort in duplication of each other's work without knowledge of what is being done. A knowledge of each other's plans might often preclude unnecessary duplication. In other cases it would insure investigations being carried on in such a manner that the results would be comparable, instead of being so uncomparable as sometimes to lend themselves to conflicting interpretations. We cannot control or compel this, but publicity is a great thing for all such evils. Might we not have a standing committee to report on the progress of economic entomology during the year and to outline the investigations under way or contemplated by American entomologists? This could be done by sending a questionaire to all our workers during the early fall and asking for replies by November 1. The report of the committee might then be published in the December number of the JOURNAL, and would furnish the basis for conference between workers interested along the same lines while at the winter meeting. It has often occurred that I have been to a meeting and afterwards learned that another man who had been there was working along the same line I was, but I did not know of it at the time. The exchange of views on such matters should be the chief value of our meetings."

The committee deemed this suggestion sufficiently valuable to merit presentation to this association at its twenty-third annual meeting, and to the end that the members might have more data for deciding whether such a feature as that suggested should be made a regular part of our meetings, requested the writer of this account to prepare a sample report. Although the time was very short, it was thought that enough material might be gotten together to admit of the preparation of a brief statement that would serve the purpose. A tabulated list of the projects that have been reported to him will be placed in your hands for the purpose of enabling you readily to

find and confer with any attending member who may be working along lines in which you are interested, and your attention will be invited to some of the striking general tendencies that prevail in the entomological projects as a whole.

Acknowledgments are due to the many gentlemen whose names and addresses appear in the tabulated list of projects.

On or about November 7, the following letter was mailed to all leading entomologists whose names appear in the recent Organization List of the Agricultural Colleges and Experiment Stations in the United States, and to such other members of the Society as were known to be actively engaged elsewhere in economic entomological work. Through some oversight, due to rush of work, the Canadian members were not furnished with a copy, and this is mentioned as a matter of keen regret because of the splendid activity shown by the entomologists across the line. No doubt still others have been overlooked, and it is desired hereby to assure them that the oversight has been unintentional and unavoidable.

MY DEAR SIR:

The accompanying suggestion was presented by Mr. E. D. Sanderson to the executive committee of the American Association of Economic Entomologists. The committee has held that this suggestion is worthy of presentation to the society, and in order that the members may have better basis for judging the desirability of making something of this sort a regular feature of our meetings, has requested me to prepare a sample report on the entomological work now going forward.

Of course, the time before the meeting is too short to permit the preparation of an exhaustive treatment, but if the workers will respond promptly, something can be done to set forth the general lines of effort and to show each man the ones who are working on lines similar to his own, and something of their methods of attack.

I should, therefore, appreciate your prompt answer to the following points, and any others that may occur to you as valuable. It is quite possible that you do not desire to give the information on some of these points. If so, omit.

For each project you are now prosecuting, state:

1. Name.
2. Object.
3. Reasons for undertaking.
4. Scope.
5. Coöperation with other departments or bureaus.
6. General difficulties you are experiencing.
7. General methods you are using.
8. Progress.
9. Source of funds used for its support.

Let me urge upon you that this report will be what you make it. If you respond fully and promptly, you will make possible a pretty good test of the worth of the scheme, but if you respond too slowly or too briefly, the result will not be worthy of your consideration.

Hoping for the favor of an immediate reply, I am

Very truly yours,

In all, 66 letters were sent out, and 40 replies were received. All who answered regarded the suggestion favorably, and 34 expressed willingness to furnish information for a sample report. Twenty-four had economic entomological work in progress and sent statements of it.

The replies showed that 25 stations which were prosecuting projects had a total of 101 under way. The numbers in the individual cases ranged from one to twelve, and the average was four. When we consider that the entomologists reporting are distributed from ocean to ocean, and from the Great Lakes to Gulf, it seems perfectly reasonable to consider their work as representative of that which is going forward in the country at large.

Of the 101 projects 97 are strictly entomological, and of these 92 may be classed as research, three as demonstration and two as law enforcement. No doubt both demonstration and law enforcement are low simply because most of the entomologists who responded understood that the suggestion referred to research work only. When the research projects are carefully examined, approximately 63% of them may be characterized as more or less fundamental studies of the life economy of some individual or group of injurious creatures, carried on in the hope of finding new measures for control or improving the ones already in use; 9.7% is concerned with the systematic relationships and life economy of a group, some members of which are injurious; 19.6% deals with the improvement of already recognized measures of control and the balance is distributed through general study of morphology, parasitism, distribution, and effect of environment.

It is thus strikingly shown that economic entomologists yet find much to do along lines of life history and methods for control study, and that only a very small minority is definitely searching for the general laws which govern insect life in its various relations. Such projects as that of Mr. H. T. Fernald on the value of insect parasitism and that of Mr. Hinds on the factors governing the production and efficiency of certain fumigants, show that this field is being tilled to some extent.

Of the projects of research more than half deal with subjects that have already received more or less attention, and in a number of cases practically the same project is under consideration at several different stations. This may be taken to mean that a considerable amount of duplication of work is occurring. The reasons for taking up subjects, which have already received or are now receiving much attention at the hands of other entomologists, are well shown in the statements accompanying the letters which set forth projects under consideration. Mr. H. A. Gossard has the following to say on this point:

"I should feel myself utterly incompetent to advise my constituents regarding the proper treatment for the codling worm, plum curculio, San José scale, oyster shell scale, scurfy scale, or a hundred other insects if I had not worked them out personally, and tested the recommendations of others, no matter from whence they came or with what authority they were backed." Again, speaking of his work on the wheat joint worm Mr. Gossard says: "We receive hundreds of letters each year in regard to this insect, and are often asked to deliver lectures upon it at Farmers' Institutes. We cannot do this satisfactorily without having a first hand acquaintance with it and are satisfied that, however good may be the work done by agents of the United States Government and entomologists of other states, we will at least be able to contribute something which they have not found." Mr. H. A. Surface has the following to say on this point: "I consider it very important for economic entomologists to work out in their own states the problems that are there present, and if results on these lines have been obtained in other states, I think it highly necessary for each entomologist first to try the methods and make personal observation of the results before he places them before the public."

Briefly, then, subjects, which have already been or are now being investigated, are made projects of research because the entomologist finds that in order to intelligently advise his constituents, it is necessary to know how measures worked out elsewhere will operate under local conditions, or that there are noteworthy differences in habit or that the commonly recommended measures are inadequate.

Whether this duplication is necessary and desirable or merely a waste of effort is also well discussed in the letters. Mr. W. E. Britton says, "There are many cases where local demand seems to warrant the taking up of work in a certain state where there has happened to be more or less duplication, and I do not see how it can be avoided. Many people expect that work of a certain nature will be done by the station, and wish to see it done in their own orchards, sometimes placing trees, labor and materials at the disposal of the station. It is hardly worth while to ignore such demands, and while there is some loss of money and effort on account of this duplication, in many cases it is a good thing in that the work of one man will corroborate that of another, or if results should differ, it simply shows that more work should be carried on along the same line." Mr. E. W. Berger says, "I am inclined to regard it (duplication of work) as a verification of each other's work. If it disagrees, it is evident that somebody has blundered and the work must be done over," Mr. H. A. Gossard says, "I believe that there has been too little duplication of entomo-

logical work in the past rather than too much. We never knew how to handle the codling moth for instance, until we had the results of many workers, and we have not yet reached full conclusions as to the exact methods to be pursued in all sections of the country. I do not think that it would be a waste of energy in the field of economic entomology, but a positive advantage to it, if every entomologist in the United States would devote more or less attention to this problem for the next two or three years and put his results in print. . . . I am satisfied that the public appreciates far more the thorough and practical solution of one big problem to which many workers have given their best efforts than it does the partial or incomplete solution of a hundred problems, more or less important, to each of which a single worker has given some time and then dropped the subject. There are at least ten or twelve great entomological problems which confront the American people, every one of which deserves the same thorough-going attention from every entomologist in the country which has been given to the codling moth work. It is doubtless a good movement to learn of the entomologists who are pursuing the same lines of work, but in my opinion, this should be for the purpose of discussion of methods and for mutual helpfulness and not with the idea that they are likely to solve the question a little too well." Mr. H. A. Surface says, "I believe that more good will finally come from parallel studies by different persons than from leaving all investigation of one topic to one alone. The personal equation is in itself sufficient to justify different workers in the same line."

Evidently, then, there is, in the opinion of many entomologists, a type of duplication that is necessary and highly desirable. It appears that the extreme importance of reliable knowledge of measures for controlling seriously injurious insects, coupled with the fact that both the life economy of the creature and the efficiency of the methods for its control will be found to vary with local conditions, renders the duplication of work incidental to study of the same subject by entomologists whose territories are seriously affected, not only permissible but necessary. At the same time there is no reasonable doubt that some of the duplication incidental to such procedure, and much of that incidental to simultaneous work on insects of little or no economic importance is a waste of time and effort, which, with full knowledge of what is going on elsewhere, could largely be eliminated.

The ultimate object of all this effort is the most complete human control of insect life that is possible, and the worth of a piece of work should be measured by the extent to which it furthers this end. In the light of this principle are we not devoting too much time to immediate life history and control, and too little to general principles and

laws? Are we duplicating one another's work too much or too little? Are there not many places where the knowledge of what is in progress elsewhere may enable us to avoid waste of effort? All these and many other questions could be taken up and dealt with in a broad-gauged manner by such a committee as that suggested.

Indeed, it seems that the multiplicity of projects under consideration, when connected with the facts that the very important pests have already had much study and that more than half of the present research work is concerned with subjects that have already had considerable attention, would render an attempt at standardization imperative. Efforts in this direction should involve not only the gathering of information on projects under consideration and presentation of it to the members of this society, but should include a broad-gauged discussion of the characteristic tendencies of the researches as a whole, pointing out the desirable and undesirable features, and suggesting changes whereby conditions may be improved.

This report should be in the hands of the members before the annual meeting in order that they may have time to prepare discussions of the report for presentation at the regular meeting.

A committee selected by this association, consisting of men who thoroughly represent the entomological interests of each of the various sections of North America, would perhaps prove the most successful means of effecting a useful and practical standardization of our work.

PROJECTS NOW UNDER CONSIDERATION AT STATIONS FROM WHICH INFORMATION WAS RECEIVED

Arthropoda
(Not insects)

	Name of Project	*Investigator*	*Address*
1	A Systematic and Biologic Study of the Crayfish of Mississippi. (Coöperation with department of rural engineering)	R. W. Harned	Agr. Col., Miss.
2	*Eriophyidae* of New York	H. E. Hodgkiss	Geneva, N. Y.
3	Red Spiders	A. L. Melander	Pullman, Wash.

Arthropoda
(Insects)

Orthoptera

4	Tree Crickets	P. J. Parrott	Geneva, N. Y.

Hemiptera

5	Efficiency of *Sporotrichum globuliferum* in dealing with the Chinch Bug	P. A. Glenn and F. H. Billings	Lawrence, Kan.

Hemiptera (Continued)

Name of Project	*Investigator*	*Address*
6 Chinch Bug Investigations. (A fundamental study of the life economy and of measures of control.)	T. J. Headlee and J. B. Parker	Manhattan, Kan.
7 Chinch Bug Disease (*Sporotrichum globuliferum*). (A study of its distribution and effectiveness in Oklahoma.)	C. E. Sanborn	Stillwater, Okla.
8 False Tarnished Bug. (A complete study of life history, habits, and methods of control.)	H. E. Hodgkiss	Geneva, N. Y.
9 Study of Leaf Hoppers Affecting Cereal and Forage Crops. (A study of their systematic relationships, life economy and geographical distribution of the insects within the United States.)	Herbert Osborn	Columbus, Ohio.
10 Apple and Pear Membracids	H. E. Hodgkiss	Geneva, N. Y.
11 Pear Psylla. (A complete study of its life history, habits and methods of control.)	H. E. Hodgkiss	Geneva, N. Y.
12 *Macrosiphum solanifolii* and Related Species. (A study of morphological, systematic and host plant phases.)	Edith M. Patch	Orono, Me.
13 Researches on the Biology of the Green Bug (*Toxoptera graminum*)	S. J. Hunter and graduate student assistants	Lawrence, Kan.
14 Green Bug Investigations. (A fundamental study of its life economy and of measures of control.)	T. J. Headlee and J. B. Parker	Manhattan, Kan.
15 Infestation of Cowpea Aphis (*Aphis medicaginis*). (A study of the life history and methods of control.)	C. E. Sanborn	Stillwater, Okla.
16 Melon Louse (*Aphis gossypii*). (A study of life history and of methods of control	C. E. Sanborn	Stillwater, Okla.
17 *Pemphigus tessellata* Fitch. (A study of life economy.)	Edith M. Patch	Orono, Me.
18 The Woolly Aphis (*Schizoneura lanigera*) (A study of life history, systematic relationships and methods of control.)	Paul Hayhurst	Fayetteville, Ark.
19 The Woolly Aphis, its Prevention and Control	H. W. Lorenz	Lawrence, Kan.
20 The Woolly Aphis. (A study of the use of pear roots as a means of eliminating its work.)	Fabian Garcia	Agr. Col., N.Mex.
21 Control of Woolly Aphis. (A study of the effect of liquid spray and tobacco dust when applied to infested orchard planting or nursery stock.)	T. B. Symons	College Park, Md.
22 Plant Louse Investigations. (A monographic study of the Colorado species)	C. P. Gillette	Ft. Collins, Col.
23 Plant Louse Remedies	C. P. Gillette	Ft. Collins, Col.
24 Ecological and Morphological Notes on Aphididæ of Maine	Edith M. Patch	Orono, Me.

Hemiptera (Continued)

	Name of Project	*Investigator*	*Address*
25	The Citrus White Fly. (A study of its biology and measures for its control.)	E. W. Berger	Gainesville, Fla.
26	San José Scale Survey and Suppression	C. B. Twigg, M. L. Breidenthal and A. J. Spangler	Lawrence, Kan.
27	San José Scale Suppression. (Locating and destroying it.)	T. J. Headlee and L. M. Peairs	Manhattan, Kan.
28	San José Scale Suppression. (Experimental and demonstration treatments in different parts of Pennsylvania.)	H. A. Surface	Harrisburg, Pa.
29	San José Scale Disease. (A study of the efficiency of *Sphærostilbe coccophila* in the control of San José scale in Oklahoma.)	C. E. Sanborn	Stillwater, Okla.
30	Peach Lecanium. (A study of the effectiveness of different oil sprays applied in fall and in spring.)	T. B. Symons and E. N. Cory	College Park, Md.
31	Investigation of the Peach Lecanium. (A study of methods of control.)	H. A. Surface	Harrisburg, Pa.
32	A Systematic and Biologic Study of the Scale Insects of Mississippi	Begun by Glenn W. Herrick and continued by R. W. Harned	Agr. Col., Miss.
33	Fungous Diseases of Scale Insects	Benjamin W. Douglass	Indianapolis, Ind.
34	Distribution of the Scale Insects of Indiana	Benjamin W. Douglass	Indianapolis, Ind.

Lepidoptera

35	The Pine-tip Moth as Affecting Young Trees on one of the Government Plantations in Central Nebraska.	Lawrence Bruner	Lincoln, Neb.
36	Grape-berry Worm	H. A. Gossard	Wooster, Ohio.
37	Codling Moth. (A study of seasonal history and spraying.)	C. P. Gillette	Ft. Collins, Col.
38	Codling Moth. (A study of life economy and of measures of control.)	T. J. Headlee and A. Dickens	Manhattan, Kan.
39	The Codling Moth. (An extensive study of life economy for the purpose of learning how to spray more efficiently.)	Fabian Garcia	Agr. Col., N. Mex.
40	The Codling Moth. (A study of spray efficiency.)	E. P. Felt	Albany, N. Y.
41	Spraying for Codling Worm. (A study of the types of treatments which will year after year give the best average control.)	H. A. Gossard	Wooster, Ohio.
42	The Codling Moth	A. L. Melander	Pullman, Wash.
43	Sod Web-worms	H. A. Gossard	Wooster, Ohio.
44	The Bud Moth and Other Apple Insects	A. L. Melander	Pullman, Wash.

Lepidoptera (Continued)

	Name of Project	*Investigator*	*Address*
45	A Seasonal Study of the Lesser Apple Worm	Benjamin W. Douglass	Indianapolis, Ind.
46	The Peach-tree Borer (*Sanninoidea exitiosa*). (A study of methods of shutting the larvæ out of the tree in relation to the period of moth emergence.)	Paul Hayhurst	Fayetteville, Ark.
47	Investigation of the Peach-tree Borer. (A study of life history and of methods of control.)	T. B. Symons and E. N. Cory	College Park, Md.
48	A Study of the Peach-tree Borer	R. W. Harned	Agr. Col., Miss.
49	Corn Ear-worm Investigations. (A study of life economy and of measures of control.)	T. J. Headlee	Manhattan, Kans.
50	Preventing the Spread of Gypsy and Brown-tail Moths	D. M. Rogers	6 Beacon St., Boston, Mass.
51	Alfalfa Web-worm. (A study of life history and methods of control.)	C. E. Sanborn	Stillwater, Okla.
52	Apple and Cherry Ermine Moths	P. J. Parrott	Geneva, N. Y.

Diptera

53	The Fungous Gnats of North America. (A systematic review of the family, life history studies, and economic bearing.)	O. A. Johannsen	Orono, Me.
54	Hessian Fly. (A complete study of life history, habits and methods of control. Coöperation with U. S. Bu. of Ent.)	P. J. Parrott	Geneva, N. Y.
55	Hessian Fly	H. A. Gossard	Wooster, Ohio.
56	Gall Midges. (A systematic and biologic investigation.)	E. P. Felt	Albany, N. Y.
57	Grape Midge	F. Z. Hartzell	Geneva, N. Y.
58	Cabbage Maggot. (A complete study of life history, habits, and methods of control.)	W. J. Schoene	Geneva, N. Y.
59	Investigation of the Apple Maggot, *Rhagoletis pomonella*. (An exhaustive study of life economy and of measures of control.)	W. C. O'Kane	Durham, N. H.
60	Structure of Root Maggots	W. J. Schoene	Geneva, N. Y.

Coleoptera

61	A Study of the Sugar Cane Beetle	R. W. Harned	Agr. Col., Miss.
62	Study of the Bean Leaf Beetle	R. W. Harned	Agr. Col., Miss.
63	White Grubs	H. A. Gossard	Wooster, Ohio.
64	A Study of the Spread of the Boll Weevil in Mississippi, with Special Reference to its Habits Under Different Environments, and of its General Biology. (Coöperation with U. S. Bu. of Ent.)	R. W. Harned	Agr. Col., Miss.

Colcoptera (Continued)

	Name of Project	*Investigator*	*Address*
65	Investigation of the Life History, Economic Relationships, and Injury of the Rice Weevil (*Calandra oryzae*) Attacking Corn in Alabama, with a Study of Methods of Control	W. E. Hinds	Auburn, Ala.
66	Plum Curculio Investigations. (A study of life economy and measures of control.)	T. J. Headlee and A. Dickens	Manhattan, Kans.
67	Plum Curculio	H. A. Gossard	Wooster, Ohio.
68	*Polydrosus impressifrons*, a Newly Imported Snout Beetle	W. J. Schoene	Geneva, N. Y.
69	Physiological Effect of Lead Arsenate on Weevils of the Order *Rhynchophora*. (Coöperation with Chemical Dept. of Station.)	Wilmon Newell	College Sta., Tex.
70	The Practical Use of Powdered Lead Arsenate in Controlling the Cotton Boll Weevil	Wilmon Newell	College Sta., Tex.
	Hymenoptera		
71	An Apple Mining Saw-fly	A. L. Melander	Pullman, Wash.
72	The Life History of a Species of Saw-fly (*Lophyrus*) that has Attacked *Pinus ponderosa* in the Northwestern Part of Nebraska	Lawrence Bruner	Lincoln, Neb.
73	A Study of the Aphidinæ. (A study of the taxonomy of the members of this group and of the life economy of the more available and important species.)	A. B. Gahan	College Park, Md.
74	The Clover Seed Chalcis (*Brucophagus funebris*)	F. L. Washburn	St. Anthony Pk., Minn.
75	Investigation of the Apple Seed Chalcis. (A study of life history, enemies and methods of control.)	H. A. Surface	Harrisburg, Pa.
76	Wheat Joint Worm as it Affects Wheat in Ohio. (A complete study of life economy and measures of control.)	H. A. Gossard	Wooster, Ohio.
77	Wheat-straw Worm	A. L. Melander	Pullman, Wash.
78	Practical Control of the Argentine Ant in Orange Groves	Wilmon Newell	College Sta., Tex.
79	Foul Brood of Bees	A. L. Melander	Pullman, Wash.
	General Subjects		
80	Insects Injurious to Stored Grains and Stored Grain Products. (A study of life economy and measures of control.)	George A. Dean	Manhattan, Kan.
81	A Systematic and Biologic Study of Insects Injurious to Pecans	Begun by Glenn W. Herrick and continued by R. W. Harned	Agr. Col., Miss.

General Subjects (Continued)

	Name of Project	*Investigator*	*Address*
82	Insects of Forest and Shade Trees	H. A. Gossard,....	Wooster, Ohio.
83	Grape Insects, Especially Root Worm, Rose Chafer, and Leaf Hopper. (A complete study of life history, habits and methods of control.)............	F. Z. Hartzell.....	Geneva, N. Y.
84	Insects that Affect Health.............	A. L. Melander....	Pullman, Wash.
85	Biological Survey of Insect Life of Kansas.........................	S. J. Hunter and F. X. Williams..	Lawrence, Kan.
86	A Study of the Actual Value of Insect Parasitism	H. T. Fernald.....	Amherst, Mass.
87	A Physiological Study of the Internal Changes Induced by Endo-parasites..	A. L. Melander....	Pullman, Wash.
88	Environmental Study of Hessian Fly and the Plant Lice Injurious to Wheat. (A study of the effect of various elements of the environment on the life economy of these creatures.).................	T. J. Headlee.....	Manhattan, Kan.
89	Some Spraying Experiments on Apples and Peaches in Foliage with Various Lime and Sulphur Mixtures to find out Their Effects as Summer Sprays Upon the Various Insects and Fungi Prevalent in Connecticut. (Coöperation with the botanist.)..................	W. E. Britton.....	New Haven, Conn.

Incidental to Insect Control

90	Investigation of the Factors Governing the Production, Diffusion, and Insecticidal Efficiency of Hydrocyanic Acid Gas and Carbon Disulphide Vapor as used in Economic Entomology.......	W. E. Hinds......	Auburn, Ala.
91	Spraying Materials and Combinations ..	H. A. Gossard.....	Wooster, Ohio.
92	Different Makes of Spraying Machinery	H. A. Gossard.....	Wooster, Ohio.
93	Dipping Nursery Stock. (A study of the effect of different insecticidal dips used on both roots and top in fall and spring.).........................	T. B. Symons.....	College Park, Md.
94	The Relation of Insecticides to the Burning of Foliage.....................	H. T. Fernald.....	Amherst, Mass.
95	The Limits of Toxicity of Lime-sulphur	A. L. Melander....	Pullman, Wash.
96	Toxicity of the Salts of Arsenic and Lead.	A. L. Melander....	Pullman, Wash.
97	Investigation of the Substances used for Insecticidal, Vermicidal, and Fungicidal Purposes,—Their Action, Relative Value, and Practical Application..	Fred. B. Lowe.....	Detroit, Mich.

Higher Animals

98	The Food Habits of Birds to Determine the Economic Value of Washington Birds............................	A. L. Melander....	Pullman, Wash.

Unclassified

	Name of Project	*Investigator*	*Address*
99	Demonstration Work. (An effort to convince the farmer that the results of experimental tests are practical and valuable.)	H. A. Surface	Harrisburg, Pa.
100	General Project. (This project is so planned that any species of insect unexpectedly demanding attention can be taken up and properly handled.)	C. P. Gillette	Ft. Collins, Col.
101	The Zoögeography of Washington to Ascertain the Life Zones, to Tabulate the Yearly Spread of Injurious Species, and to Note the Yearly Abundance of Pests	A. L. Melander	Pullman, Wash.

PRESIDENT SANDERSON: We have but a few minutes in which to discuss this paper. What is your pleasure?

MR. LOWE: I notice from the paper Mr. Headlee has presented that is does not include my work. I also notice that he classes in general all entomologists as bureau or station, but there is at the present time another class of entomologists. I do not know how you will quite classify them—they are those who are engaged in work for commercial organizations, fruit growers' associations, sugar planters' associations, those interested in the manufacture of insecticides, etc. It seems to me they are a distinct class, and as some are engaged in deep research work, it seems to me they should be included. I should take pleasure in handing Mr. Headlee an account of my work. Regarding the duplication of work, that is a very interesting thing to me, because, as it happens, I have discovered at this meeting that a member of this association is going over the same ground that I worked out a year ago and nearly completed, and I was not in the least aware that he was working on the same problems about a hundred miles away from me.

MR. HEADLEE: Mr. Chairman, an explanation is probably due. As my time was very short, and it was necessary to get the material together immediately, I turned the matter over to my stenographer with general directions, and the oversights were due to the fact that I did not watch close enough, and that I failed to give minute directions, and, of course, all due apology is due these people, and is hereby tendered.

MR. SUMMERS: On behalf of the membership committee I should like to ask that if the names of any new members are to be handed in, that they be on the regulation blanks, to be had at the secretary's desk, and be handed in not later than this afternoon to Prof. J. B. Smith, the secretary or myself. In regard to another matter, that of associ-

ate membership and active membership, if any of you has a friend whom he thinks should be raised to active membership, who is now on the associate list, please do not mention that fact incidentally to members of the committee, but supply the committee with information in writing, giving a list of his publications. Certainly, if you cannot, in the case of a man you know well enough to wish raised, give information concerning him, you cannot expect us to furnish that information here in the brief time allowed.

By vote of the association the session adjourned.

Afternoon session, Wednesday, Dec. 28, 1910.

The meeting was called to order at 1.30 p. m. by President Sanderson in joint session with the Entomological Society of America.[1]

President Sanderson: The next paper is on "The Effect of Certain Gases and Insecticides upon the Activity and Respiration of Insects," by G. D. Shafer, East Lansing, Mich.

THE EFFECT OF CERTAIN GASES AND INSECTICIDES UPON THE ACTIVITY AND RESPIRATION OF INSECTS[2]

(*Abstract*)

By G. D. Shafer, *East Lansing, Mich.*

This paper, as well as the one following on lime-sulphur is a brief of results of some work done on the general subject of how Contact Insecticides kill insects. Early in the study of this subject, it was found that scarcely any insecticide depends upon only one property for its effectiveness. Yet, as a rule, some one property is chiefly concerned. For example, strongly alkaline washes enter the spiracles or penetrate the chitinous covering into the body of the insect and dissolve the fat and proteid portions of the tissue cells. Substances commonly used as fixing agents in histological studies such as corrosive

[1]The following papers were presented and will be published, together with the discussions thereon, in the Annals of the Entomological Society of America; "Some Notes on the Pear Slug, *Eriocampoides limacina* Retz." by R. L. Webster, Ames, Iowa, and "The Locomotion of the Larva of *Calosoma sycophanta*," by A. F. Burgess, Melrose Highlands, Mass.

[2]A more complete account of work mentioned in this paper, as well as the paper on Lime-Sulphur Wash, together with figures of apparatus, tabulated data, etc., will be published shortly in a technical bulletin of the Department of Entomology, Experiment Station, Michigan Agricultural College.

sublimate, penetrate the chitin and precipitate proteid bodies of the tissue cells.

Furthermore, kerosene, and some of the insecticides commonly known as the miscible oils appear to depend chiefly on some other property still. It has been generally believed that these latter substances enter the spiracles and suffocate the insects by shutting out fresh air from the tracheæ. By the use of the stain, Sudan III, in kerosene, gasoline, and such fluids, and by the use of Indigo Carmine in emulsions of the miscible oils, it was shown that contact insecticides of this type do enter the spiracles and tracheæ of plant lice. The same was true also of caterpillars and insects having a protective closing apparatus for the tracheæ, if the fluids were applied thoroughly enough. But, while the presence of these bodies in the tracheæ might interfere with the passage of air, it appeared that the insecticides must kill in some other way than by merely plugging the tracheæ and depriving the insect of oxygen. Insects, which are killed rapidly by kerosene or gasoline, may revive after many hours' confinement in hydrogen, carbon dioxide, or nitrogen. Some species are able to recover after being deprived of oxygen for a much longer period than others. Moreover *Passalus cornutus*, which is quickly killed by gasoline, is able to recover entirely after being submerged for two minutes in pure oleic acid—until all the tracheæ leading from the spiracles are filled. The oleic acid is an oily substance which would be as capable of plugging the tracheæ as gasoline or kerosene.

At 72° to 84° F. it was found that the vapor of the following substances would affect insects: Gasoline, benzine, kerosene, to-bak-ine, pyro-cresol, pine oil disinfectant, creolin, crel oll, chloro-naphtholium, zenoleum, aniline oil, and creosote.

The vapors of the more volatile of these liquids at saturation will kill many insects as rapidly as when an abundant supply of the liquid itself is applied. Death, in the case of the vapor, could scarcely be due to a plugging of the spiracles. Small amounts of the vapor or of the liquid of any of these substances act upon insects much as the common anæsthetics, ether and chloroform. *Passalus cornutus* is a good insect to use in studying the action of these bodies. One can note upon the first application of a small amount of one of these substances, excitement and a more rapid heart beat. Under the influence of larger amounts the actions become uncertain and the heart beat irregular; then the insect will become quiet, and the heart-beats slower and slower until they cease entirely and death results. Hydrocyanic acid, hydrogen suphide, and the volatile portions of pyrethrum act in very much the same way.

It was found that small amounts of kerosene, gasoline, pyrethrum,

etc., increase the rate of excretion of carbon dioxide in insects. Large amounts of the same substances, as they brought about quiet and death, reduced the output of carbon dioxide. When the output of carbon dioxide was increased, the amount of oxygen used increased; as the output of carbon dioxide decreased, the oxygen used decreased in about the same ratio, until when the insect was deeply under the influence of the insecticide (this was tried out especially with gasoline vapor, hydrocyanic acid gas and nicotine) and nearly dead; then the respiratory ratio increased. That is, the amount of carbon dioxide given off was greater in proportion to the oxygen used than was normal.

As evidence that this increase in the respiratory ratio is due to the insecticide, it was shown that death from starvation or from mechanical injury causes a decrease in the respiratory ratio.

Insects confined in pure hydrogen, nitrogen or carbon dioxide, give off carbon dioxide; and the rate of its excretion under this condition, it was found, is often increased by gasoline or by hydrocyanic acid gas—never decreased appreciably, although insects placed in nitrogen for 8 to 10 hours after treatment with one of these insecticides, seemed to recover as well as if they had been left in air. Indeed, the chances of recovery of the former often seemed to be better.

By actual measurement of the gases, it was proven that certain gases and vapors are absorbed into the bodies of insects and that in an atmosphere of pure air, they may be given off again. In case of some gases, their presence in the insect body can be shown by injecting solutions which, upon contact with the gas, give rise to colored precipitates. For example, hydrogen sulphide can be detected in this way by a solution of lead acetate or of cadmium chloride—a black sulphide precipitating in the former and a yellow sulphide in the latter case. The evidence from microscopic sections of insects treated in this way seems to indicate that some tissues of the insect take up the gases or vapors in greater amounts than others. Moreover, the activities of the insects under the influence of the vapors and gases named,—as has already been mentioned,—indicate that the nervous system is especially affected.

Experiments upon the luminous organs of the larva of *Photuris pennsylvanica* indicate that the light-giving power of these organs is due to an oxidation process, since the light of intact or of excised organs ceases in the absence of oxygen (*i. e.*, in carbon dioxide or in nitrogen) and may begin again when air is admitted. Now it would appear that the presence of carbon disulphide vapor interferes with oxidation in these organs since the luminosity decreases and may even be made to cease when the organs are exposed to a sufficient amount of the vapor. The luminosity may then be made to reappear if the

organs are kept moist and brought immediately into pure air or oxygen again.

It is believed that these experiments upon the action of contact insecticides justify the following statements:

Contact insecticides as a rule effect the death of the insect through more than one cause.

Alkaline insecticides, such as the strong soap washes pass rather slowly through the chitinous walls of insects and dissolve the proteids and fats of the tissue cells.

Corrosive sublimate and similar substances, which in solution precipitate proteids, pass slowly through the chitinous walls of insects and precipitate the proteids of the tissue cells.

Most gases penetrate the chitinous walls of insects into the body, rapidly—much more rapidly than liquids.

Gases and liquids may enter the tracheæ through the spiracles and there penetrate the walls of the tracheæ into the body tissues of the insect more rapidly than through the outer chitin. Apparently the more feeble the surface tension of the liquid, the more readily is it able to enter the spiracles of the insect.

In the case of gasoline, kerosene, carbon disulphide and many such insecticides which are volatile, the volatile portions penetrate the body through the tracheæ and through the outer chitin, thus affecting the insect long before the liquid alone would have time to do so. Such insecticides may plug the tracheæ to some extent, but they appear to be effective principally through their ability to interfere, in some way, with the processes of oxidation in the tissue cells.

SOME PROPERTIES THAT MAKE LIME-SULPHUR WASH EFFECTIVE IN KILLING SCALE-INSECTS.

(*Abstract*)

By G. D. Shafer, *East Lansing, Mich.*

In making a study of how the lime-sulphur wash kills scale-insects, it was found that after treatment with the spray, for several hours before death results, many of the insects lie under their scale coverings in a more or less comatose condition. During this time, if the scale is removed, the insect speedily recovers the ability to respond when touched with a needle. Of course after a few hours in dry air the delicate bodied insect would shrivel and die, but fresh air seemed to be the thing that revived it when the covering was first removed.

Haywood ('07) showed that lime-sulphur sprays contain polysul-

phides of calcium which become oxidized on exposure to air; the products of this oxidation being, at first, calcium thiosulphate and free sulphur. The thiosulphate, itself, he found to be finally oxidized to calcium sulphate. In order to determine whether this process of oxidation might deprive a scale-insect of oxygen when treated with a lime-sulphur wash, measured amounts of the spray were placed either on absorbent paper or glass-wool in containers above mercury with measured amounts of air. Then after various periods of time, the amount of oxygen in the confined air was determined. In this way, it was found that large amounts of oxygen are required to oxidize the calcium polysulphides present. For example, a piece of absorbent paper (10 x 12 cm.) saturated with lime-sulphur (Baume 20.1°) used 87.5 cc. of oxygen in sixteen and one-half hours. If the paper on which the solution was placed remained moist, the polysulphides would all be oxidized in a few hours. If the paper were quickly dried, the remaining sulphides oxidized much more slowly, requiring several days. The thiosulphate of calcium oxidized more rapidly when kept moist than when dry, but in any case, it used oxygen more slowly than the sulphides.

It was found, moreover, that the bark of a dormant apple tree at 11°to 12° C. was using small amounts of oxygen and giving off carbon dioxide. The space beneath a scale covering on such a tree, freshly sprayed with lime-sulphur, must therefore be losing its oxygen from three causes—namely, the oxidation of the lime-sulphur, the respiration of the bark of the tree and of the insect itself. Very few specimens of San José scale could recover after being kept 14 hours in an atmosphere of pure nitrogen.

It was found, also, that lime-sulphur is able to soften the wax around the outer edge of the scale covering of very many of the scales. The older, firmer wax did not dissolve. If the spray passed under the scale covering, its presence could be detected there by the use of corrosive sublimate which gives a black precipitate with the polysulphides of calcium. If only the thiosulphate remained its presence could be detected by silver nitrate with which a black precipitate results.

When the wax, softened by lime-sulphur around the edges of the scale, dries, it often sticks the scale covering so firmly to the surface of the plant as to seal the insect. Sometimes the pygidium was found sticking fast to the dry scale covering. In the case of *Aspidiotus ficus* on orange, seven days after spraying, as many as 22 dead young, 9 living young, and 4 eggs were found sealed in beneath the shield with the mother. Such confinement of course must result in the death of all the family in a few days. After three to four weeks it was found that in many cases, the oxidized salts in the wax of the scale stooled

up forming a white crust which lifted the scale covering so that it might easily be washed or brushed from the tree, thus exposing any helpless insect, not already dead, to weather conditions.

Sulphur dioxide could not be detected coming from a surface treated with lime-sulphur wash, unless when nearly dry, the surface was exposed to temperatures high enough to rapidly vaporize the free sulphur present. It would seem therefore that under natural conditions sulphur dioxide is not formed in sufficient quantity to be of any insecticidal value.

If carbon dioxide is dissolved in lime-sulphur wash, hydrogen sulphide will be formed. This gas is poisonous to insects; but no means was found of proving its presence in effective amounts beneath scales treated with lime-sulphur.

It was not found with certainty, in any case, that lime-sulphur wash penetrated into the body of the insect, although it would kill the cells of a small part of an insect's body touched by it, while other parts of the body remained alive for a time.

The experiments therefore, seem to show that with lime-sulphur wash, it is mainly the combination of the three properties or conditions already described which makes the insecticide so efficient against scale-insects—especially against San José scale which winters in a partially grown condition.

Mr. Headlee: I have enjoyed this paper very much, and wish to thank Mr. Shafer for it. It is a type of work we ought to have more of. A few thoughts occurred to me while this paper was in process of being given, and one of them is this: Why does the author think that gasoline dissolved out parts of the fat body? Is it not possible that something else entered in and produced the same morphological result?

Mr. Shafer: Mr. President, I think the gasoline affected the "fat body," because in every case where it, alone, was tested for the right length of time, gasoline dissolved the fat body. If kerosene were used it would leave the fat body intact after two hours' treatment. This did not affect the fat body very rapidly, but after a certain number of hours, say eight or ten, I found that the "fat body" began to be dissolved, and in the case of gasoline, if the insect be left in for say twenty-four to thirty hours it will dissolve practically all the fat of the "fat body." The fat will be in solution in the gasoline, so that we can say that is the agent bringing about this result.

Gasoline and kerosene, however, kill the insect before any noticeable solution of the fat body takes place. It is the alkaline wash that can dissolve the "fat body" in one portion of the body of an insect while the other portions of the body are still alive and able to move for a time.

MR. LOWE: I wish also to compliment Mr. Shafer upon his work; it is very, very excellent, and right along my line. I am sorry I have not got our chemist here to dip into the chemical questions he raised. But my findings, I am sorry to say, are not entirely in accordance with his, particularly in some of the fumigants mentioned, which I found did not kill, and some substances I found killed certain insects, and had no effect upon others. There is one other point, and that is clogging spiracles. I have made many experiments along that line, with a great many substances, and have not been able yet to clog the spiracles of an insect. I have used the Cecropia caterpillar, painting the spiracles with kerosene, but have not been able to kill the insect. There is another thing, some of the insecticides, such as ordinary pyrethrum, will kill insects, but other substances equally fine, such as flour and many other substances, have no effect upon the insect when they are entirely immersed in them. I have many criticisms of the paper, but they are more in the light of friendly discussion than criticism.

PRESIDENT SANDERSON: This paper is undoubtedly one we want to digest somewhat before we can discuss it intelligently. We have certainly felt the need of some work of this kind, those of us who have attempted to teach the whys and wherefores of insecticides.

We will now take up the symposium on "Present Methods of Teaching Entomology." The paper prepared by Professor Comstock will be read by Mr. Ruggles.

THE PRESENT METHODS OF TEACHING ENTOMOLOGY

By J. H. COMSTOCK, *Ithaca, N. Y.*

The present methods of teaching entomology followed in the United States have been developed almost entirely by men now teaching this subject. A second generation of teachers has begun its work; but the first is still on the stage. We have progressed far enough, however, to make it worth while for the teachers to compare methods, in order that each may profit by the experience of the others.

In a conference of this kind the contribution of each to the discussion will be, naturally, at first, merely a statement of the methods evolved in our several widely separated institutions. Then can follow comparisons and discussions of the various methods, which may result in the modification of each. I regret exceedingly that I cannot be present to hear the papers of my colleagues, and to take part in the discussion. But unfortunately for me, I can only send my report of progress.

The first professor of entomology in an American university was Dr. H. A. Hagen, who held this position in the Museum of Comparative Zoölogy of Harvard University. But, although the influence of Doctor Hagen upon the few pupils who had the good fortune to study with him was very great, his teaching of entomology was subordinate to his researches in systematic entomology and his work as curator of the great collections of insects of that museum.

Although Doctor Hagen came to the Museum of Comparative Zoölogy in 1870, his first course of lectures was given in the summer of 1873, and his class consisted of a single student, the writer of this paper. That was a course of lectures never to be forgotten by the one who heard it. It was a very hot summer, and Doctor Hagen suffered with the heat. About nine o'clock each morning he would come into the laboratory, say a cheery good morning, take off his coat and hang it back of the door, take off his vest and put it with his coat, take a seat by a small table, light a German pipe with a very long flexible stem, place the bowl of the pipe on the floor behind him, take a few puffs, and then say, "Come and I will you tell some dings what I know." The student would then take a seat on the opposite side of the table, and the professor, with sheets of paper before him, which served the purpose of a blackboard, would take up the subject where it had been dropped the previous morning.

I take the space to narrate this personal experience because this course of lectures had a profound influence in shaping the development of my teaching of entomology. It was just at the beginning of my experience as a teacher of this subject. Although still an undergraduate, I had given one course of lectures in the institution with which I am connected, and the broadening influence of this master came at a very opportune time. Thus early I gained a hint of the scope of entomology, and was led to realize that the practical applications of this science should be based upon a broad and accurate foundation of scientific knowledge.

One, however, must not forget that nearly all of the chairs of Entomology in this country owe their existence to the economic bearing of this subject; it is almost only in agricultural colleges that we find professorships of entomology; and they have been established in these colleges because of the great importance to agriculture of insect pests.

While, therefore, the teacher of entomology should teach the science of entomology, he should not fail to make practical applications of this science so far as possible.

Let us turn now to the more specific problems that the teacher of entomology must meet. In discussing these I will state the conditions that exist in the institution with which I am connected; and will

briefly outline the methods with which the entomological staff of this institution is trying to meet these conditions. In other institutions other conditions doubtless exist, which can be better met by other methods.

The students of entomology in Cornell University can be grouped into four classes; and the special needs of each of these classes must be considered separately in order to reach the best results in our teaching. We have what are termed "Special Students," students who take a short course of study in general agriculture extending over only one or two years; regular students in a four-year course who take entomology only as part of a course in arts and sciences or in general agriculture; regular students in a four-year course who are fitting themselves for entomological work; and graduate students.

First, special students. The special or short-course students can devote so little time to any of the several subjects that they study during the one or two years of their stay in college, that we are able to give them only two periods of entomology per week for a half year. In this brief course given to a class consisting largely of students who have no background of biological knowledge, we can only hope to give some information that will be of immediate practical use to them in their growing of crops or their care of stock, when they return to their farms a few months later.

The course consists of very elementary discussions of the structure and metamorphoses of insects, of accounts of the more important insect pests, with suggestions as to the best methods of combating them, of accounts of beneficial insects, and of field excursions to observe, so far as practicable, the insects discussed. The course is illustrated by many sets of specimens, put up in the Riker mounts, by diagrams, and by a liberal use of the stereoptican and the projection microscope.

Owing to the fact that this course is given during the months of October, November, December, and January, the field-work part of it is of necessity limited. We expect that in the near future there will be a summer session of our College of Agriculture, when an elementary course can be given in which a more desirable balance between lectures and field-work can be obtained.

This course for the special students differs so fundamentally from what we consider desirable as constituting the entomological part of a course leading to an academic degree, that regular four-year students are not permitted to elect it. We look upon it as merely extension work given at the college.

Second, regular students not specializing in entomology. The class of students whose needs are to be considered next are those regular

students in the four-year course of the College of Agriculture who elect entomology as a part of a course in general agriculture and those students in the College of Arts and Sciences who wish to take some entomology but do not care to specialize in this subject.

For these students we give a course consisting of two lectures per week throughout the year and one laboratory period of two and one-half hours each week during the first half-year.

In this course the object is to give information by lectures and training in observation by laboratory work. The students in this class have some foundation of biological knowledge, as a year's work in general biology or a year's work in zoölogy is a prerequisite for admission to the course.

During the first half-year the lectures are on the characteristics of the orders, suborders, and the more important families of insects, and on the habits of representative species; the laboratory work includes a study of the structure of insects and practice in their classification. During the second half-year the subject is treated from the economic standpoint. In the lectures the more important insect pests and methods of controlling them are discussed; and at opportune times the class is taken into the field to observe insect pests at work. It is planned to expand this course by the addition of one period of two and one-half hours per week of laboratory work in economic entomology, which shall be taken in connection with the lectures of the second half-year.

It is obvious that in a course consisting so largely of lectures, the imparting of information plays a more prominent part than does the giving of scientific training. But the latter element is not lacking. The lectures are so planned that the student in preparing for the required examinations, which come at frequent intervals, must obtain some conception of the foundation principles of the science. And in the laboratory work, where the more general features of the structure of insects, both external and internal, are studied, and where a large number of specimens are classified, the student is given some training in accurate observation.

Third, regular students specializing in entomology. It is for this class of students that the greater part of the work offered by the department of entomology has been planned. All of our courses, with the single exception of the course designed for the special students, is open to them; the only restrictions being that certain elementary courses must be taken before advanced courses in the same field can be elected, and a year's work either in general biology or in zoölogy is a prerequisite for regular work in entomology.

In all of the courses taken by this class of students, the imparting of

information is subordinated to the giving of a training that shall enable the student to ascertain facts for himself. Much more attention is given to laboratory and field work than to lectures. Thus at the outset, these students when taking the introductory course on general entomology, described above, take only the lectures, and instead of the "one-hour" (2½ hours actual time) laboratory work, take first a "three-hour" laboratory course (7½ hours per week) in elementary morphology of insects and then a "three-hour" laboratory course in elementary systematic entomology; the two constituting a "three-hour" laboratory course throughout a year.

In this elementary laboratory course the student is held to the performance of his work in the most accurate manner possible for him, and we usually convince him that he can do it more accurately then he thinks he can at first. We care comparatively little for the facts that he learns. It is not much to have learned the more general features of the external anatomy of a grasshopper; but it is a great deal to have worked out these features in a painstaking way. It is here in the performance of this elementary work that is largely determined the kind of a worker that a student is to be. It rarely happens that a man who persists in doing slovenly work here becomes a careful worker later. It sometimes takes considerable time for a student to learn to work in a careful manner, but if he has the right kind of stuff in him he will learn before the end of this year's work. If he does not do so, he is advised to devote himself to some other field of activity. Here, as elsewhere in nature, a thinning-out process is necessary to produce the best results.

I have given considerable space to the discussion of this course, for we regard it the most important course in our curriculum; it is the foundation on which all the other courses rest. Later the student who has been started in the right way needs only to be given the facilities of the laboratory and library and occasional suggestions as to methods of work and interpretation of results.

I will not take the space to describe in detail the more advanced courses. Those who are interested will find them listed in our Announcement of Courses, a copy of which I will append to this paper. A few words, however, regarding the organization of our department of entomology may be of interest.

The work in systematic entomology is under the direction of Dr. A. D. MacGillivray. It includes the elementary work in this field, already referred to, and several special advanced courses. One of these, a three-hour course (*i. e.*, 7½ hours per week for a half-year) is devoted to the classification of the Carabidæ. This family was selected because it contains many genera, and these are separated

by minute but definite characters, the determination of which gives an excellent training in accurate work. It was also selected because it is easy to purchase of dealers sufficient material so that each student can have for his own collection a set of the genera studied. Then there is a five-hour course (*i. e.*, 12½ hours per week for a half-year) on the classification of the Coccidæ; this is a combined lecture and laboratory course, which enables the student to obtain a knowledge of the classification of this important family, and to acquire the ability to accurately determine species belonging to it. There is also a laboratory course on the classification of immature insects, and a lecture course on the literature of systematic entomology.

An advanced lecture course on the morphology and development of insects is given by the writer assisted by Dr. W. A. Riley. This course is supplemented by a course on the histology of insects. This is under the direction of Doctor Riley, and is largely a laboratory course. The students in this course work individually, some devoting much more than the minimum time required, which is three laboratory periods per week throughout the year. It is here that the students get their training in histological methods, and thus lay a foundation for research work in either the morphology or the development of insects.

Courses on the embryology of insects, on the relation of insects to the diseases of higher animals, and on parasites and parasitism, are also given by Doctor Riley. The last two courses are taken by many students in the Veterinary College and by premedical students in the College of Arts and Sciences.

The work in economic entomology is under the direction of Professor Glenn W. Herrick, and consists of both elementary and advanced work in this field. The work in the morphology of insects and in systematic entomology, taken in other divisions of the department of entomology, is here supplemented by a course in advanced economic entomology and insectary methods, in which the student is trained in the technic of breeding insects, mounting of specimens, insect photography, the preparation and application of insecticides, and other details of insectary work.

In the courses on limnology, which are given by Dr. J. G. Needham, and which treat of the life of inland waters, much attention is given to the study of aquatic insects, and especially to their ecological relations to each other and to other aquatic organisms. A considerable part of this work is carried on at a biological field station, located in the midst of the marshes at the head of Cayuga Lake, and easy of access from the University; so that the work can be continued during the college year as well as in the summer.

Fourth, graduate students. The work of each graduate student is

planned for him individually; and the nature of it is determined by his needs and attainments. Usually this work is largely research; and it is expected to be independent and original. All of the facilities of the department and of the university library are placed at his disposal. He is given advice as it is needed; and is required to make frequent reports on the progress of his investigation. When these reports are made, the results obtained are carefully scrutinized, and frequently suggestions are made as to methods of attacking the problem other than those already employed. But the constant effort of the instructor is to teach the student self-reliance. The completed thesis must be satisfactory in style and composition; and if illustrated, as is usually the case, the illustrations must be suitable for publication.

At the final examination the student is examined not merely on the subject of his thesis, but also on the fields in which his major and minor subjects have been taken. A major and one minor are required for the Master's degree, and a major and two minors for the Doctor's degree. These subjects must be in different fields, under the direction of different teachers. The obvious object of this requirement is to prevent too narrow specialization.

There is space merely to refer to a course in German entomological reading, a course on the morphology and classification of the Arachnida, and to the entomological seminar which meets weekly for the discussion of current entomological literature, and at which advanced students present the results of their investigations. Much is made of this feature of the seminar, as, by means of it, the entire department can keep in touch with the more important work done by the different members of it; and the students presenting papers get experience in public speaking. At this seminar the members of the staff of the department also present the results of their investigations.

In conclusion, I wish to say a word about undue specialization in entomology. Frequently young men come to us who wish to study only entomology, and sometimes those even who wish to devote themselves to the study of a single order of insects; such specialization is never permitted. Usually such students need one or two years' study of languages and of other sciences than entomology to fit them to take up special entomological work profitably. And even when they are fitted to take up this work, it is not best for them to devote themselves exclusively to a single division of the subject. For example, the man who is fitting himself to be an experiment station entomologist should study insect morphology and systematic entomology as well as economic entomology. As "the worst weed in corn may be corn" so a too exclusive study of entomology is the poorest kind of preparation for an entomologist.

Appendix

The course for special or short-course students is No. 16 in the following list of courses.

The courses for regular students not specializing in entomology are Nos. 3 and 8.

The *introductory* courses for regular students specializing in entomology are the lectures of Course 3, and Courses 4, 5 and 8. Any or all other of the courses (except Course 16) may be elected by these students.

Biology

1. **General Biology.** Throughout the year. Three hours. Lectures (2) T Th, 10. *Auditorium.* Practice (1) M T W Th or F, 2–4:30 or S, 8–10:30. *Main 302.* Assistant Professor Needham, Professor Comstock, and Messrs. Matheson and Lloyd.

Prerequisites. None.

This is an elementary course designed to acquaint the general student with the main ideas of biology through selected practical studies of the phenomena on which biological principles are based. Both lectures and laboratory work will deal with such topics as: the interdependence of organisms, the simpler organisms, organization and phylogeny, oögenesis and ontogeny, heredity and variation, natural selection and adaptation, segregation and mutation, the life cycle, metamorphosis and regeneration, and the responsive life of organisms. The object of so general a course is to give a bird's eye view of the biological field and an elementary acquaintance with the principles of development.

This course and Entomology 22 and 23 may be taken to meet the requirement of biology for entrance to the Medical College.

Entomology and General Invertebrate Zoology

(1. **Invertebrate Zoology.** Not given by this department in 1910–11. See Course 1 in Department of Vertebrate Zoölogy in the College of Arts and Sciences.)

2. **Morphology of Invertebrates.** Either term. Two or more hours. Lectures, none. Practice by appointment. *Main 301.* Assistant Professor MacGillivray.

Prerequisites. None.

The comparative study of the anatomy of representatives of the principal groups of invertebrates.

3. **General Entomology.** First term. Two or three hours. Lectures (2) M W, 9. *Main 392.* Professor Comstock. Practice (1) for those who have not had Courses 4 and 5, Th or F, 2–4:30. *Main 301.* Assistant Professor MacGillivray.

Prerequisites. Biology 1 or Zoölogy 1.

Lectures on the characteristics of the orders, suborders, and the more important families, and on the habits of representative species. The practical exercises include a study of the structure of insects and practice in their classification.

4. **Elementary Morphology of Insects.** Either term. Two or three hours. Lectures, none. Laboratory open daily ex. S, 8–5. *Main 391.* Assistant Professor W. A. Riley and Mr. ———.

Prerequisites. None.

An introductory laboratory course, required of all students planning to do advanced work in the Department of Entomology.

5. **Elementary Systematic Entomology.** Either term. Three hours. Lectures, none. Laboratory open daily ex. S, 8–5. *Main 301.* Assistant Professor MacGillivray and Mr. ———.

Prerequisite. Entomology 4.

A study of the wing venation of insects and the identification of specimens belonging to the more important orders and families. An introductory laboratory course required of all students planning to do advanced work in the Department of Entomology.

6. **Advanced Systematic Entomology.** Either term. Three hours. Lectures, none. Practice by appointment. *Main 301.* Assistant Professor MacGillivray.

Prerequisite. Entomology 5.

A training course in the identification and interpretation of obscure characteristics used in the classification of insects.

7. **Histology of Insects.** Throughout the year. Three or more hours. Lectures (1) first term, Th, 11. *Main 392.* Practice, either term, by appointment. Assistant Professor W. A. Riley.

Prerequisites. Entomology 4 and 5.

Designed for students of general zoölogy, as well as for those preparing for research in insect morphology.

8. **Economic Entomology.** Second term. Two hours. Lectures (2) M W, 9. *Main 392.* Assistant Professor Herrick.

Prerequisite. Entomology 3.

Discussion of the more important insect pests and of methods of controlling them. At opportune times the class will be taken into the field to observe insect pests at work.

9. **Advanced Economic Entomology and Insectary Methods.** Second term. Two hours. Lectures, none. Seminar, field and laboratory work by appointment. *Insectary.* Assistant Professor Herrick.

Prerequisites. Open only to graduates and to undergraduates who have had Entomology 3, 4, 5, and 8.

Economic problems connected with applied entomology, discussed, reported upon, and field observations made. Experimental methods in breeding, photographing, investigating, and controlling insects discussed and studied. Designed for advanced students in entomology who desire to fit themselves for Experiment Station work.

10. **Classification of the Coccidae.** Second term. Five hours. Lectures (1) by appointment. Practice by appointment. *Main 301.* Assistant Professor MacGillivray.

Prerequisite. Entomology 6.

A course designed to familiarize the student with the more injurious species of scale insects, the methods of preparing specimens for study, and the systematic arrangement of the species.

11. **Morphology and Classification of the Arachnida.** Either term. Three or more hours. Lectures, none. Practice by appointment. Professor Comstock and Miss Stryke.

Prerequisites. Open only to graduates.

12. **Morphology and Development of Insects.** Second term. Two hours. Lectures (2) T, Th, 9. *Main 392.* Professor Comstock and Assistant Professor W. A. Riley.

Prerequisites. Entomology 1, 3, 4, and 5. Students are advised to take Entomology 7, also, before taking this course.

14. **German Entomological Reading.** Either term. One hour. W, 7–9 p. m. *Main 391.* Assistant Professor W. A. Riley.

Prerequisites. Open only to advanced students in entomology or zoölogy.

16. **Elementary Economic Entomology.** First term. Two hours. Lectures (2) T, Th, 9. *Main 392.* Assistant Professor Herrick.

Prerequisites. None. A course designed for special students. Not open to students who are prepared to take Entomology 8.

Discussion of insect pests in general, with remedial suggestions. Occasionally, the class will be taken to the field to observe insect pests at work.

[17. **Literature of Systematic Entomology.** First term. Two hours. Lectures (2) W, F, 8. *Main 392.* Not given in 1910–11. Assistant Professor MacGillivray.]

Prerequisite. Entomology 5.

A systematic study of bibliographies, indexes, and general entomological literature; the preparation of catalogues of insects; the evolution of the rules of zoölogical nomenclature; and the methods of determining the priority of generic and specific names.

[18. **Embryology of Insects.** Second term. One hour. Lectures (1) Th, 9. *Main 392.* Not given in 1910–11. Assistant Professor W. A. Riley.]

Prerequisites. Entomology 3, 4, and 5. Alternates with Course 12.

19. **General Limnology.** Second term. Three hours. Lectures (1) at an hour to be arranged. Practice (2), laboratory or field work T, 2–4:30, and a second period by appointment. *Main 302 and Biological Field Station.* Assistant Professor Needham and Mr. Lloyd.

Prerequisites. Open only to students who have taken or are taking General Biology 1 and Entomology 3.

An introduction to the study of the life of inland waters. Aquatic organisms in their qualitative, quantitative, seasonal, and ecological relations.

20. **Research in Limnology.** Throughout the year. Three or more hours. Practice by appointment. *Main 302 and Biological Field Station.* Assistant Professor Needham.

Prerequisite. Entomology 19 or its equivalent.

A course consisting of laboratory and field work.

22. **Animal Parasites and Parasitism.** First term. Two hours. Lectures (1) T, 8. Practice (1) M or T, 2–4:30. *Main 392.* Assistant Professor W. A. Riley.

Prerequisite. Must be preceded or accompanied by Biology 1 or Zoölogy 1. Entomology 3 is also advised.

A consideration of the origin and biological significance of parasitism, and of the structure, life-history, and economic relations of representative animal parasites.

23. **The Relations of Insects to Disease.** Second term. Two hours. Lectures (1) T, 8. Practice (1) T, 2–4:30. *Main 392.* Assistant Professor W. A. Riley.

Prerequisites. Must be preceded or accompanied by Biology 1 or Zoölogy 1. Entomology 3 is also advised.

Considers primarily the agency of insects and other arthropods in the causation or the transmission of diseases of man and animals.

24. **The Classification of Immature Insects.** Second term. Two hours. Lectures none. Practice (2) by appointment. *Main 301.* Assistant Professor MacGillivray.

Prerequisite. Entomology 5.

A course in the taxonomy of nymphs, larvæ, and pupæ.

27. **Research in Morphology of Insects.** Throughout the year. Three or more hours. Lectures, none. Laboratory open daily ex. S, 8–5, S, 8–1. *Main 391.* Professor Comstock and Assistant Professor W. A. Riley.

Prerequisites. Entomology 3, 4, and 5.

Special work arranged with reference to the needs and attainments of each student.

28. **Research in Systematic Entomology.** Throughout the year. Three or more

hours. Lectures, none. Laboratory open daily ex. S, 8–5, S, 8–1. *Main 301.* Professor Comstock and Assistant Professor MacGillivray.

Prerequisites. Entomology 3, 4, 5, and 6.

Special work arranged with reference to the needs and attainments of each student.

29. **Research in Economic Entomology.** Throughout the year. Three or more hours. Lectures, none. Laboratory and field work by appointment. *Insectary.* Professor Comstock and Assistant Professor Herrick.

Prerequisites. Entomology 3, 4, 5, and 8.

In most cases it is impracticable to complete an investigation in this subject during the college year. Students must arrange to conduct their observations during the growing season.

Seminar. Throughout the year. Monday, 4:30 to 5:30. *Main 392.*

The work of an entomological seminar is conducted by the Jugatæ, an entomological club which meets for the discussion of current literature and of the results of investigations. Attendance at the meetings may be counted as laboratory work.

President Sanderson: The next paper which was prepared by Dr. H. T. Fernald will be read by Dr. Back.

PRESENT METHODS OF TEACHING ENTOMOLOGY

By H. T. Fernald, *Amherst, Mass.*

In teaching entomology, much depends upon the ultimate aim of the student. A course in introductory entomology, whether as a required or an elective subject is sure to include many students who will not continue the subject farther. It is at least probable, that these students will form over half of the class, and accordingly, the introductory treatment should be arranged on the basis of the greatest good to the greatest number. This will usually mean some slight knowledge of insect anatomy, particularly external anatomy, and a general survey of insects as a group, with special attention to the pests of greatest economic importance in the region where the majority of the students taking the course are likely to settle, together with a rather careful consideration of methods for the control of these pests, and with field work, so far as possible, which shall enable the students to recognize them and their work.

The advanced work, following the introductory course, would naturally be for those students who wish to make entomology their profession, or who wish to use it as collateral knowledge in other lines of work, such as fruit growing, forestry, market gardening, etc. Under such conditions, a course best adapted for one, might be far from the best for the others, and it would seem that an important point to keep in mind is that the course should have elasticity. Certain portions of

the work should be common to all, while other parts should be radically different, in order to best meet the needs of the different students. This means individual training, and I cannot too strongly urge that the best results come from a careful study of the plans of each student, and the shaping of quite a part of his work with direct reference to those plans.

For those not intending to make entomology a profession, but who wish to be able to recognize, or if this is impossible, to determine insects which they may find attacking the crops they raise, the course should aim to teach the student how to obtain the answers to the questions which will so often arise in his work—"What is this pest, and how can I control it?" External anatomy, therefore, so far as this is necessary for the identification of insects is essential, and the writer has found that the most satisfactory way of teaching this is by the careful study of the external structure of a rather typical insect of each of the more important economic groups, followed by the identification, at least as far as families, of quite a large number of insects. The course in external anatomy should assure the familiarity of the student with those parts used in analytical keys, while the determinative work to follow, will call his attention to variations in these parts, besides giving him practice in the use of the keys themselves.

It seems to the writer that too little attention has been paid to the question of insecticides, in connection with this work. He gives, and is heartily in favor of quite an extensive course of lectures, together with as much laboratory work as is possible, on the different insecticides, their chemical composition, preparation, methods of detecting adulterations, etc., and this course could be extended with profit.

Beyond this point, however, he believes that the work of the students should be, to a large extent, individual, and that the man going into fruit raising for example, should make a careful study of the insects most seriously injuring the fruits he expects to raise, both in the field, in the laboratory, in the collections available, and in the books. Of course, within the ordinary time limits of such a course, it is impossible to cover all the insects of any crop in this way, but the more important ones can be considered, and the man will thus be enabled to recognize the most important pests or their work, when he may find them, and take active measures at once for their suppression.

In this way, the student who receives the training outlined above, will recognize many of his insect enemies without study, but if this is not the case, he knows what steps to take, in order to ascertain the foe which is attacking his crops, and having determined this, is in a position, as the result of his studies on insecticides and other measures of control, to utilize the best methods for its destruction.

For the student who expects to make entomology his life work, the problem is somewhat different. Such a man must know all the important insect pests, and be able to identify those which he may not recognize. He must thoroughly understand the various methods of controlling these insects, and must be able to successfully raise insects through their early stages to the adult condition, in case a pest can not be recognized until it is adult. In other words, he should understand how to do systematic work, life history work, and how to conduct methods of treatment, and this should not be knowledge gained from books or in the lecture room alone, but by practical experience. And it is here that the difficulty of adapting collegiate sessions to entomological work appears. Structural and systematic work can easily be conducted during the winter, and methods of treatment, to a slight extent, can also be undertaken at this time, but the larger part of all field work, which is so important, must either be begun so near the end of the spring term that the student leaves before it has been completed, or must be undertaken entirely during the summer vacation, when he is not ordinarily available. Under such conditions, the only substitute is to give as thorough a training as possible along the lines of external anatomy already indicated, and in the systematic determination of insects, and then as much as possible in the other lines, and it is an interesting comment that correspondence with a large number of men trained in this way, who have been out of college for some time, shows that they feel that they are weakest, not in methods of control, nor in life histories, but in their ability to identify the insects with which they have to deal, and they frequently state in the correspondence, that in their work, which is largely economic in its character, they feel the need of more extensive systematic training.

How much of this it is possible to give within the limits of an undergraduate course, will naturally, of course, depend upon the amount of time allotted to the subject, and this is something that is rarely in the hands of the teacher in charge. A college course, as laid out by a college faculty, is usually more or less of a compromise, and while the elective system in the last years, permits of some specializing, it is at best, specializing within a certain group of subjects, rather than in any one. Perhaps this is a good thing in some ways, for the broader the foundation in college, provided the man is able afterwards to specialize, the better will be the results, and Agassiz's remark to his students at Penikese, "Learn something of everything, and everything of something," is still in the opinion of the writer, a fundamental principle.

In too many cases, however, the college course, which, from this standpoint, should be the place to learn the "Something of everything," is the last opportunity for training, and if we attempt to crowd

into this four years the "everything of something," as well, the results are liable to be unsatisfactory in both directions. For the intending graduate student, therefore, I would urge a broad undergraduate course, with plenty of chemistry, physics and botany, but with sufficient attention paid to the cultural subjects, and those connected with our duties as citizens, to give breadth in every way. Languages as tools, aside from their cultural value should not be omitted, and if such a course as this for the future graduate student in entomology must mean a reduction in the amount of undergraduate entomology which he could take, I would still advise such a course, believing that the concentrated study of the one subject to follow after graduation would be much more valuable when placed upon such a foundation.

Starting with this, the graduate student is in a position to go ahead rapidly. I hardly think it comes within my province to discuss lines of work for graduate students, but if we remember that after completing his course, he will be expected to have personal experience in methods of control, methods of rearing insects and in identification, it would seem desirable that these three lines of work should be given great stress in his training, and at the Massachusetts Agricultural College, it is the present purpose to recognize this by requiring an original piece of research in each of these three lines, to constitute the thesis, rather than one piece of work, perhaps three times as large. The student may get out a splendid thesis, well worthy of an advanced degree, on the median segment for example, requiring nearly all his time for three years to prepare, but it is probable that one of the first questions he will meet on taking a position thereafter, will be as to the relative merits of two different brands of arsenate of lead for spraying. Under such conditions as these, the writer favors what he may term the tripartite thesis.

In conclusion, an opinion cannot be too strongly expressed as to the amount of supervision to be given graduate students. The idea of letting a graduate student "work out his own salvation," without any supervision is, in the opinion of the writer, a serious mistake. The average student on graduation has been so carefully led by the hand and guided for four years, that he really does not know how to take a step by himself. Of course, he will learn, but even the best man loses much time and often gets discouraged in this process. It would seem wiser to begin graduate work under much the same supervision as that given to undergraduates, but to gradually reduce this, so that after six months or so, a man is generally working for himself. Thus, the time and money of the student are saved, greater progress is made, and the great change from the nature of undergraduate work to that of graduate work is successfully bridged over. In this way, the stu-

dent loses no time, and can make his advanced work more satisfactory and more profitable than would otherwise be the case.

PRESIDENT SANDERSON: Professor Osborn will present the next paper.

THE PRESENT METHODS OF TEACHING ENTOMOLOGY

By HERBERT OSBORN, *Ohio State University*

In a discussion of the methods of teaching entomology, it is almost necessary to take a hasty view of the growth of the subject and of the different methods of imparting knowledge in it during the past half century. We need scarcely go back of this, because for the United States, at least, the growth of the teaching of entomology as a subject included in a college curriculum has had its growth within that time. In fact, practically all of the development of the teaching outside of two or three localities has been within the last twenty-five years. Naturally the methods in vogue in the early teaching of the subject were derived from the teaching of related subjects such as Botany and Geology, but even for these the different programs of instruction were in a very crude form up to thirty or forty years ago. The growth of the methods of teaching has necessarily followed the growth of the subject as an application for economic purposes as well as for the impartation of knowledge as a science. Naturally, then, for the teaching of Economic Entomology the development of methods must have been within very recent time.

The early plan of teaching was quite naturally that of the lecture system, partly because of the scattered condition of the material and lack of definite texts in the science, and partly because of the prevalent idea that the lecture system was the most satisfactory and, perhaps, the least troublesome to the teacher. Later, however, this was combined with more or less of field work, and then with some laboratory courses, and at the present time the method which I suspect is the most general is a combination of these various methods; that is, more or less of the lecture system including illustrations by chart or lantern, or collection incorporated in class work, along with text references and quizzes. These associated with definite laboratory courses, with dissections of typical forms, and a definite allotment of field work involving the collection of material in its natural habitat, its preparation for preservation, and more or less of identification for the practice in systematic work. These methods, of course, vary with regard to

the preparation of the students and the progress they have made in their studies. For more advanced work it includes the most precise methods of microscopical study and all of the refinements that have been evolved with reference to the study of minute anatomy and the special methods of field research to determine ecologic conditions.

Entertaining lectures about insects or insect habits, while they may still have value as inciting interest in the subject, but which are largely forgotten at the end of the term, go a very short distance in the way of effective training for exact scientific work in entomology. This must come by continued and concentrated individual application. It can be stimulated but not accomplished by the efforts of the teacher.

At present we may consider that there are at least three phases of the teaching of the subject to be considered: First, the instruction given in scientific institutions, and especially with reference to the training of investigators or teachers who expect to follow the work from a professional standpoint; second, the instruction given in agricultural colleges or other schools especially for the purpose of giving information to those who will use it in the application of measures of control for the insects with which they have to contend in their daily life work; and third, the instruction which is now becoming an important feature given in the shape of extension courses to people outside of college and school environment, and which takes the form of lecture work in the extension course or the publication of instructive matter in agricultural journals or other media of publication.

It is evident that the methods available in these different lines of instruction must vary, and that while each has its very important place, the effort should be to adopt methods which will be most effective in the different spheres. This may involve the utilization of teachers of quite different capacity or training, but, nevertheless, it appears to me must involve for each a thorough and accurate foundation in the essentials of the science. As for the necessity of the different lines, it is clear that there can be no definite progress in the matter of thorough training for the two latter groups except as we have the solid basis of fact determined by accurate and prolonged study of the conditions upon which to base the instruction given. There is, therefore, the necessity that we should have trained investigators for the acquisition of further knowledge concerning insects, the discovery of which is one of the most important duties of modern entomology. For the purpose of this kind of instruction it is absolutely necessary that there be thorough training in related sciences, as well as in the general foundation in other branches of knowledge. It appears to me that the work in this line should naturally be built upon as thorough a foundation as required for advanced training in any line of knowledge. Ento-

mology is distinctly a special branch of science, and in order to secure a breadth of view or to acquire for it the proper outlook, it should not be entered upon, at least for its special features, until the student has been thoroughly grounded in those branches of knowledge which he must use in the furtherance of his work. I believe that a thorough course in zoölogy should by all means precede the special study of entomology, and if with this there can be extended work in botany and geology, as well as chemistry and physics, the student is so much the better qualified to secure a proper perspective and to accomplish effective work either in investigation or instruction.

The equipment for the teaching of this subject is pretty well established, and there is I think considerable agreement in the different institutions where the subject is seriously taught. In practically every institution which I have visited recently I have found that there is a full recognition of the necessity for a collection of insects which shall be representative of the different orders for service as a basis for the identification of species, and where advanced work is attempted, serve for the investigation of various groups and sometimes for theses on monographic subjects. That collections in entomology should be even more essential than in general zoölogy is quite a natural result of the immense numbers of species with which we have to deal, and the fact that specific recognition is such a fundamental necessity in the proper handling of economic as well as of morphologic problems.

Equally important with the collection is the equipment of apparatus, microscopes, etc., which are essential in the detailed anatomical and morphologic studies, and with these there will be in all cases a necessity for facilities for the tracing of life histories and the study of problems of development. Just how far this matter shall go is evidently a question of opinion, or in some cases a question of resources, since the building of elaborate insectaries is a matter of considerable expense. That there shall be some provision for controlling the conditions and facilitating observation in life histories is granted, but it is evident that very much in the way of thorough training can be done in the field, and with moderate equipment in this direction.

I have had an opportunity to visit a large number of institutions where departments of Entomology were at work, and it has happened in a great many instances that the insectaries have just at the time of my visit been unused because the problems on which the entomologists were engaged were being conducted from the field and laboratory standpoint. This has occurred so frequently that I have been somewhat puzzled to know whether the insectaries furnished so much of advantage as they were expected to, but nevertheless I am very free to grant that there are many problems in which they must be of great

service, and both for instructional purposes and investigation must have a place. For the purpose of instruction I am inclined to think that they will be of the greatest service in connection with work laid out for advanced students, and that for the more elementary students better results can be obtained by field and laboratory methods.

The extent to which a department must be provided with books and such accessories is one in which I think we shall all agree that the more that can be secured the better, but I do not feel that any department need neglect the subject because of a scant equipment in this direction. If students are forced to go more directly to the subjects themselves there is certainly some advantage, although the access to extended literature is helpful, and for some subjects, absolutely indispensable.

The other element in the problem, and the most fundamental one of all appears to me to be the teacher, and here it is difficult to make any very specific statements. In the earlier development of the subject it seems to me that a great deal more depended upon the individuality of the teacher than at present. So much depends upon the stimulus given to the student as to his effective work that in the earlier development of the subject it was very largely a matter of this individual work. At present a student may acquire his enthusiasm from a number of associated workers and fellow students, as well as teachers, or be stimulated by the recognition of the fact that there is a distinct demand for workers in this field. My own feeling is that students should be given as great a freedom of action as possible, and that especially after they have entered upon advanced work the teacher should occupy the position of a helpful guide rather than that of a dictator in the work. A student who does not have enough interest and enthusiasm in the subject to work independently, or who does not have enough independence and originality in his work to go beyond the outlines furnished by his teacher, is in most cases hardly worth the extended effort of the teacher. If he is too distinctly directed in this course he will fail to branch out into lines which will be a means of growth to himself or of distinct advantage in the progress of the science.

As a concrete example of the courses of study in this line, it may be permissible for me to outline briefly the courses offered in my Department, with some hints as to the purpose and method in each.

The work in the College of Agriculture for four-year students begins with a year of general zoölogy, including considerable attention to economic phases of the subject and embracing a discussion of the group of insects, with indication of the orders, some life histories and habits, with certain applications for injurious forms.

This course is followed by a year of general economic entomology, which is intended primarily as a course to give the elements of the subject in a broad way, but informing the students as to the divisions of the group, the principal phases of life cycles, especially those which are at the basis of measures for control, to discuss remedies, use of insecticides and apparatus, and in short to put the student where he may intelligently consult the literature of Entomology which is available in experiment station and other entomological reports and apply practical modes of treatment. The course includes for class work, lectures, quizzes and examinations, with laboratory work devoted to the dissection of typical examples in the different orders, carried far enough to give some acquaintance with both internal and external structures, and particularly with such structures as are at the foundation of classification. Students are also required to collect and prepare a representative series of insects with classification carried far enough so that they become acquainted with the various divisions used in this work.

Such a course, we believe, is fitted to prepare a student not only for the general work which may follow in any field, but also to furnish a basis in case he determines by this time that he wishes to go further into the subject, or to make it his profession.

For advanced courses the student may start at the beginning of his third year in college by taking advanced entomology based upon the two years of preceding work, and for this course there is given a thorough review of the anatomy, physiology and development of insects with special attention to the phases of metamorphosis, or life cycles and adaptations which constitute such a very important basis for the problems of control. The scientific basis for methods of applying insecticides, the use of apparatus and the application of cultural methods, use of parasites, diseases, etc., are fully discussed. It also includes a practical study of the scale insects intended to cover an important economic group and as giving training in the technique and taxonomy of a group. In this connection also we usually discuss the questions of legislation, quarantine, inspections, etc., with, later, the selection of some particular group or species upon which a more exhaustive study is made. Such a study serves as a training in the use of entomological methods and to give a greater familiarity with apparatus, collections and library. Following this course which has occupied a year, a student may engage upon a year of special research work devoted to a particular problem. This may be taken in connection with a course in invertebrate embryology covering the various phases of development in the invertebrates at large with a considerable time in the study of the embryonic development of insects.

There is also a course in invertebrate zoölogy which is open to election and which may be taken either before or in connection with the course in advanced entomology. This course, dealing with invertebrates in general and devoted to morphology, relationships and life histories, serves to give a broad knowledge of the phases of invertebrate life and to form a better basis for acquaintance with insect structure and development. It embraces especially dissections, microscopical studies and special technique in preparation of material for study.

Advanced students are also expected to carry a course of seminary work, which includes reports upon current literature, reports upon the personal study of the student, or the discussion of such special scientific topics as may be of special interest during the time in which the course is running. This enables the student to gain practice not only in the preparation, but in the presentation of results in his work. For graduate students there is a requirement for the preparation of a thesis in which the student does practically all of the work which is common in the preparation for publication of an exhaustive scientific paper.

For the more elementary training there is offered a course to students of the short course, and others who have had no training in zoölogy, this course running through one year and being taught in a more elementary manner, simply on the basis of a lack of knowledge of general zoölogy. It aims to give an acquaintance with the groups of insects, especially those which are of economic importance, a study of the measures of control, and an effort to acquaint them with so much of the technique of the subject that they can intelligently use the reports of experiment stations and other general publications.

It appears to me that something along this line is the most essential thing to provide in the courses presented at institutes or in extension work, because there is certainly a considerable gap between the average cultivator and the entomological literature presented in agricultural journals, station bulletins and other published material. Whatever can be done to reduce this gap, to make our knowledge available to the public at large, is not only a desirable but an essential thing for the progress and utilization of economic entomology.

Considering the immense changes which have taken place in the teaching of entomology in the last quarter century and the rapid movement at the present time, it is certain that marked changes will occur in the future years, and probably one of the desirable things at the present time is to indicate if possible the lines along which such development may occur, or to suggest features of improvement. Otherwise, I take it this symposium would have no particular object.

It appears to me that there is need of still further specialization in

the work of presenting entomological matter, and that there must be naturally a larger division of the subjects of entomology, so that certain phases of it may be presented by those who are most thoroughly equipped for the purpose. The time is evidently past when all the different branches of entomology can be presented thoroughly by a single individual. While it is desirable for the sake of sympathetic action and coöperation that each one should be acquainted with the lines of work engaged in by others, for the sake of real progress it is necessary that each one should restrict himself in special work to a limited branch. This means a differentiation into systematic, morphologic, physiologic, embryonic and ecologic groups at least, and it is hardly possible to speak of any one of these as being of greater importance than the others. Systematic work is absolutely essential for accurate indication of the forms on which work is done, and it in turn must be based on thorough acquaintance with structure and development. An acquaintance with the physiological activities must, I think, grow greatly in importance as the development of experimental work toward the control of insects is developed. At first sight knowledge of the early embryonic stages may seem less important than post embryonic development, but it has become more and more apparent that many problems which have ultimate economic importance are wrapped up in this phase of the subject.

In addition to these there are the special fields of medical entomology and of behavior which have developed into quite important subjects within the last few years. Both of these may be taught in connection with other more general matter, and on some accounts it appears to me that this is much the better plan, since it is then possible to preserve the practical relationships which are an important thing for the student to secure. Medical entomology, however, has been making such strides and is becoming so distinct a branch, that it may require more special treatment. It was noticeable in the Congresses held during the past year that one of the most prominent topics for discussion was the relation of zoölogy and entomology to medical science, and there were some very urgent pleas that these be given a greater measure of attention. Experimental zoölogy has also considerable to offer in the way of particular treatment, and is doubtless to be reckoned as one of the important lines for development. Here again, however, it appears to me that there is some advantage in the close association of this work with the more general work upon life histories and habits, and I am not sure that the advantage to be derived from close specialization in the subject will outweigh the loss from its separation from the more general phases of the subject.

It is very evident indeed that much of this matter will specialize

largely in the future. This will make it more and more difficult to completely cover the important phases of entomological work in one place, and will, I think, further require a greater amount of migration of students who wish to get the latest and best of methods in any particular branch. Such a migration of students, already somewhat in vogue, is, it seems to me, a very desirable feature both for securing a broadening effect upon the student from working with different individuals, and for the stimulating effect it has upon the instructors themselves.

With regard to the teaching of entomology in the lower grades of school work, there seems to me to be a distinct problem and one that is deserving of most careful attention. Under the name of Nature Study and other terms considerable of this work is already in progress or is being urged with greater or less force. It is a subject which interests the economic entomologist particularly, because the education of the general public in some of the fundamentals of the subject would permit him to make his results known with much greater facility. I have heretofore, in an address before this society in Boston twelve years ago, indicated the belief that it would be unfortunate to force such work into the lower grades of school work before we have teachers sufficiently trained to give the work with a fair degree of success. It appears to me that to force such work in with incompetent or uninterested teachers would simply delay the longer the practical adoption of such work, and therefore be an unfortunate feature for entomological science. It seems to me necessary that accurate knowledge in such lines should be carried from the higher grades of school work downward, and that as soon as a fairly sufficient body of teachers is available, the extension of such work into the lower grades will be practicable. This period should be much nearer to us at the present time than it was a decade ago, as there has been a very extensive growth of interest in such work, and a large body of teachers more or less trained for the handling of such a subject. It is still a fact, however, that many of the teachers attempting such work have more enthusiasm than knowledge, and are no assistance in the real extension of interest. These conditions will undoubtedly improve rapidly as the subject becomes more widely understood and the demand for such information increases from the outside. There is so much at present being presented in the general magazines, in agricultural literature, and in the form of accessory school work, that it can be only a question of time that greater efficiency will follow.

President Sanderson: Professor Bruner will present the closing paper.

PRESENT METHODS OF TEACHING ENTOMOLOGY AT THE UNIVERSITY OF NEBRASKA

By LAWRENCE BRUNER, *Lincoln, Neb.*

When our Secretary sent out his preliminary notification of this meeting and asked me to take part in a discussion of "present methods of teaching Entomology," the matter at first seemed of little importance so far, at least, as the speaker was concerned. However, after giving the subject some thought I have decided that it might be well at least to take the time and trouble to attempt to explain briefly a few of the methods by which the student in Nebraska is enabled to absorb some entomological information. In order to do this with an unbiased feeling it might be well as an introduction to state that the speaker began his work as Experiment Station entomologist with the explicit understanding that no teaching was to be required of him. During the twenty-two years and over since becoming connected with his present position matters have changed somewhat. Today the greater portion of the time of the entomologist, during the school year at least, is taken up with instructional duties. A department of Systematic and Economic Entomology has developed; and, thanks to the grade of students choosing the work, fairly well equipped men have been turned out to take their place among the working entomologists of the country.

It should be strictly understood by my audience also that the speaker does not consider himself a teacher in any sense of the word, neither is he conceited enough to claim any great amount of credit, if credit be due, for the plan followed in making entomologists at the University of Nebraska. The methods, if any exist, have simply evolved. Again if my audience understood the courses offered and the different classes of students who take these courses, it would be an easier matter to describe our method of teaching the subject. Of course in Nebraska as elsewhere not all the students who are obliged to take up entomological studies do so with the intention of becoming trained specialists, neither do they register for the work with the expectation of learning all there is to be known concerning insects. In fact, though I do not like to confess it, many of the students who do register for entomology in our institution, do so under the impression that they are registering for "a snap." Others register because entomology is required in the particular group of studies which they have chosen. A very few students in the beginning have decided that they would like to take entomology for its own sake, but none choose the study of insects because by doing this they expect to make it the stepping stone to an independent fortune.

After it became evident that some teaching would be required of the station entomologist, a sort of general course was outlined and a series of talks prepared with the object in mind of giving the student some sort of an idea concerning the nature of insects and their relation to man. These talks were at first delivered at irregular intervals and readings were suggested for filling in the gaps. From time to time other information along entomological lines was sought for and attempts made to supply the desiderata. In this manner several distinct courses have been developed so that at the present time the student has an opportunity to select at least a dozen or more distinct lines of work in the department. In the School of Agriculture the entomology offered at present is simply in the form of a series of lectures of the nature already mentioned, and no laboratory work aside from reading is asked of the students. By far the larger number of our students are of this class. It might be well to add parenthetically that even the domestic science girls are obliged to listen to the haranguing of the entomologist hoping that they will learn something about protecting the weary wayfarer from the attacks of certain insect enemies of man and, incidentally, also learn how to fight flies and brush lice off their house plants. It is likewise expected that after having pursued this study they will adopt the most approved methods of catching and killing fleas.

The real entomological instruction, however, begins with a course on general entomology in which the Class Insecta as a whole is reviewed. In this course the professor attempts to outline his talks in such a manner as to describe Arthropod structure, to give information concerning the transformations, distribution and behavior of the various represetatives of the Class Insecta, and to a limited extent of the more nearly related forms; to describe the chief characteristics of the orders, suborders and important families of insects, as well as to mention and describe briefly the life-histories and habits of typical species. These lectures are usually arranged so as to be accompanied by suitable stereoptican views. In connection with the lectures all students who register for this course are obliged to do certain laboratory work, two hours in the laboratory being required for each lecture period. In the laboratory the student is expected to make dissections of typical representatives of the various insect orders and also to try to represent the work being done by drawings. This course in general entomology is planned to meet the demands of both the general and the special student because, since certain of our courses in the College of Agriculture require entomology later on, these general students must necessarily take up different lines of entomological work the basis for which is practically the same. Our special students, however, who intend to make entomology their major subject while in college are handled quite

differently, as will be shown further on. In the laboratory work just referred to only the coarse external structure is studied so as to obtain sufficient knowledge of the anatomy of insects to aid in their classification. In connection with the laboratory and lecture work some readings are required, though not extensive, it being supposed that the lecture notes, if taken down rather fully and studied later on will be of sufficient guidance to the student to enable him to gain the information which it is the instructor's desire to impart. No regular text-book is used till the second semester when the student is advised to secure a copy of either Comstock's Manual or Kellogg's American Insects. The special student, however, is required to study all of the texts he can find the time to examine.

In the second semester of the year the laboratory work is greatly modified. The student is now supposed to learn to discriminate between orders, families, genera and species. In other words, the student is taught to classify insects. He is also supposed to do some field work, this field work to consist of collecting insects, noting something concerning their food-habits, their methods of life, their distribution, and in some instances even to observe life-histories by means of rearing and taking notes on one or more common forms. In his food-habit investigations he is directed to note the difference between carnivorous and herbivorous; he is also led to see the difference between predaceous and parasitic insects. In connection with the lectures for the semester such subjects as "parasitism," insect dispersal or distribution, effects of climate, insect diseases, reproduction, methods of insect control, artificial and natural, etc., are discussed. As my audience may imagine, it is hoped in this manner to make the general entomology a basis for the special work which is to follow later on in the student's college career.

While it would be possible for the entomology student to pursue his morphological and embryological studies in the department of entomology, it has been our custom in Nebraska to have him do this in the department of zoölogy which is better equipped for this class of work. In like manner the department of horticulture is better equipped for spraying demonstrations in connection with the handling of certain fruit and shade tree pests.

In speaking of methods pursued in teaching the special student, it might be well to add that should the student decide before beginning his work in the department of entomology and inform the instructor that he intends to specialize, he would be given additional laboratory work in connection with the study of the insect's body, some internal anatomy in addition to the external structure which is required of the general student. He would also be directed to register in the depart-

ment of zoölogy where he should take a course known as "General Zoölogy." He is likewise requested to take a similar course in botany as early in his college career as possible.

It might be of interest for me at this point to state incidentally that in training students for doing entomological work it has always been the aim at Nebraska to see that our students study such languages as Latin, German, French and, if convenient to do so, also to add at least one semester of Spanish or Italian. We have thought this action on the part of the student to be of much importance since so many of the entomological publications which he must consult during his career as an entomologist are published in these languages, and he should be able to read them in a sort of way at least. In addition to the study of languages and the botany and zoölogy already referred to, we aim to have the special student learn how to construct synoptical keys or tables of the orders, families, genera and species. For the purpose of testing these tables they are put in the hands of first-year students who should be able to determine insects by their aid, and until this is possible, the student is requested to continue to revise He is also set to work on preparing bibliographies of various kinds. These bibliographies deal with such subjects as the insect enemies of some particular order, family or genus; or possibly, they are based on the literature referring to the various insects affecting some special host-plant, or it may be constitutes the literature referring to the insect fauna of some special region.

After having started a student on his road towards specializing in the subject of entomology, although he may be but a second or third year man, it is our custom to have him decide upon and elect some particular group for his more especial study. When he has done this, one of the first things necessary is the gathering together of both the available material and literature. After this has been accomplished he is requested to look over various published bibliographies so as to find and designate the additional literature necessary to be secured by the department in order to enable him to carry on his studies. In the meanwhile he is set to work collecting all such material in the line of specimens of the insects to be studied that it is possible for him to secure. While doing the collecting, if any interesting facts are observed in connection with the specimens being studied, it is required that notes be made describing such characteristics, etc. Later on in the course of his studies these notes are to be used as a basis for papers to be written and which can be used, if so desired, towards satisfying the English department's demand for themes. Occasionally these papers can also be utilized in the local entomological club to which all special students of entomology belong. In this manner the student is enabled

to satisfy, to some extent at least, two or more of his instructors with the same expenditure of time and waste of gray matter.

Reference has been made to the Seminar work in connection with the local entomological club. It might be well to state that all efforts put forth by the student in preparing papers for, and in taking part in, the discussions of this club are recognized by the department of entomology to the extent that regular college credit is given for these efforts. The head of the department, however, reserves the right to criticize and correct the papers thus offered to the same extent that he would papers prepared exclusively for the department.

In teaching the systematic side of entomology our method has always been to start the student out by having him learn to recognize at a glance the orders to which various insects belong. After he has succeeded in doing this fairly well so far as the larger and more easily recognized orders are concerned, he is then required to pick out representatives of some of the principal families of each of them, and later sections of families or genera, and finally species.

In our instructional activities in Nebraska we have attempted to include as much field work as possible. We accordingly have our second, third, and fourth year, as well as graduate students accompany the professor on field trips whenever practicable. This plan, by the way, was the usual custom in earlier years at Nebraska and some of the first students who were trained obtained a very large percentage of their entomological training in this manner. During later years, however, this scheme has been less convenient on account of the lack of facilities for getting out into the state and afield. During the earlier years our railroads were permitted to issue complimentary transportation and the professor of entomology was not averse to accepting as much of this kind as it was possible to persuade the companies to issue. Accordingly many of the field trips in past years lasted for periods varying from a day or two to two or three months in extent and most of the accessible portions of the state were thus reached and more or less carefully studied. This plan of having the student accompany the professor into the field was not entirely a one-sided proposition either; since by the combined energies of many special students, during the numerous field expeditions, there has been an accumulation of a much greater number of facts concerning our insect fauna than could otherwise have been accomplished.

While referring to lectures as a means of instruction it might be of interest to state that we have found considerable value in the use of "startling statements." By "startling statements" is meant references to peculiar structural features as found in certain insects, odd life habits, rapidity of multiplication, location of some of the sense

organs, etc. Such statements in our judgment tend towards working up interest among non-technical students. It is sometimes possible that by such simple methods an occasional non-entomologically inclined student will become aroused from his apathy in "bugs" and "bug lore" and gain an interest sufficient to lead him into life-history investigations on his own account, and later to the adoption of entomology as a study. Of course when once started he will go on and become a "bug crank" of whom it will be said, "When in college he studied and collected bugs" and perhaps in after life choose to occupy some of his leisure time in studying some group of insects as a pastime.

In Nebraska we have seldom obtained our special students by trusting to their coming in and choosing the study by themselves. In most instances our students have been "discovered." Such "discoveries" were made during visits to farmers' institutes, teachers' association meetings or while addressing some of the high schools and other organizations out over the state. We have even "discovered" a few special students through correspondence concerning some of the many insect enemies which are to be met with over the state. Occasionally young men have become sufficiently interested in some peculiar appearing insects that they have come across in their wanderings, or special insect attacks, to write to the entomologist concerning them. In our replies to these letters for information a little ingenuity often creates a desire for further information that leads the young man to begin investigations of his own. After we have learned of such an interest on the part of the various young people, they have often been induced to enter the University and take up studies in this department. In this way we have chosen men who were really interested in the study of nature in several of its branches before they came to us. After the choice was made, and the student had arrived, it then became our duty or at least an effort was made to provide the means whereby the student could pursue the desired studies without permitting him to feel that he was making too great a sacrifice of time and energy. Once the student has entered the department with the intention of becoming an entomologist, and has gone through with his general courses and had a little other training sufficient to be of aid to him while pursuing individual investigations, he is encouraged to take up special or research work. It has been our experience that nearly every young man has in mind some particular line of the work that he would prefer to follow in preference to others. Everything else being equal it would be best, therefore, for him if he could choose in a line with his desire. Should the student choose to specialize in forest entomology he is accordingly encouraged to learn some general prin-

ciples of forestry; if, on the other hand, he has an idea that he would prefer to study the insects that attack fruit and ornamental trees, it is the principle of the head of the department to suggest that he take some work along the line of horticulture. If the student wishes to make a special study of insects in their relations to diseases, then a medical course is prescribed, etc.

In addition to some of the other general requirements of the special student in the department of entomology in the University of Nebraska and which have already been referred to, it has always been insisted by us that he should learn report writing, proof reading, editing, etc.; in fact, he should learn to act as a sort of private secretary to the entomologist by taking dictation and writing many of the economic and other letters of the department. He is also utilized at times throughout the several years of his college course as laboratory instructor, librarian, breeding-cage overseer and to perform such other matters as incidentally come up from time to time in the department, including "janitor work, bottle washing, and cooking," as one student remarked not long ago.

Fortunately in Nebraska it has been possible for the professor who is also the state entomologist to turn some of the special funds which have been appropriated by the State Legislature from time to time, for his use in fighting insects, so as to put them into the hands of these special students by engaging them to assist in the various kinds of field investigations that come up from time to time as well as to pay them for some of the time allotted to the various activities mentioned above. In this manner it was and is possible to keep the student occupied in entomological work during the summer vacation. While perhaps not giving him as much income as he might obtain from other employment, the continual coming in contact with matters entomological in part compensates him for the shortness of the pecuniary compensation.

President Sanderson: The discussion will be led by Dr. Smith.

Mr. J. B. Smith: Mr. President and Gentlemen: I think we all appreciate the difficulty of discussing this series of papers, where almost every phase of the subject has been treated very thoroughly. There seems to be one agreement on the part of all who have taken up the subject, and that is, the desirability of laboratory work, and as much of it as is possible; and the marvel to me has been, as I have listened to the papers, where in the world the time comes from for college students to do all that is expected of them. Now, I will admit that so far as my teaching is concerned, I have never been able to

secure time to do what apparently has been done by other teachers. The nearest approach to it has been brought out by Dr. Fernald but only incidentally in some suggestions. He said, if I recollect, that it was important that the student should have a good general knowledge, that he should have a good foundation for work, and that if anything had to be cut in the making of an entomologist, the entomology might, in some cases, be cut to good advantage; and now I am not sure but that is true. That a relatively small amount of entomology in the undergraduate course is in itself as good as the devotion of a great amount of time, a number of hours through the entire course, to the neglect, necessarily, of some fundamental study. There seems, also, in all the papers, to be rather an ignoring of what might be called an Eastern college course. The point of view seems to be from the standpoint of a rather mature student, a man who enters the college with the idea of pursuing a certain study, and who has a definite point in view. In our institution in New Jersey the first year is prescribed for all scientific studies; there is no election. The idea is that every man who enters college should have a fundamental training that leads to making a good citizen of him. Entomology does not enter into the course until the second semester of the junior year at all, and for those students that take only the biological course that is all the entomology they get, and that is all that they have time for. Now we work our men six days in the week—five full days, morning and afternoon, and more or less the sixth day, and they work from nine o'clock in the morning—some of them consider chapel work, too—and until four o'clock, and some until five o'clock. That is a long enough day for a college student, and if taken thoroughly, is all he can do. In that first semester, or rather the semester in the junior year, both the biological and agricultural students are placed on the same plane, and the object in that course is to teach them something about the structure and the general classification of insects; the relation of insects to other animate nature,—that is their place in nature, and as the course is developed, a considerable amount of time is given to diseases, both of plant and animal. A great many of our men who take the biological course do so as preliminary to a medical course. We do not aim, in our institution, to turn out trained entomologists. Those students who pursue the agricultural course have not the time; agriculture in its broad sense will take up the time of any man for four years if he wants to pursue it, and leave only a small margin for entomology. In the last half of the senior year the agricultural students get a training in economic entomology, but that training is not enough at any time to turn out a man who is ready to take a position for entomological work.

In planning the course I have distinctly eliminated the idea of training men to take positions in entomology. I have advised men who have taken the course with me, and who have wished to specialize in it, to go somewhere else for the postgraduate course, particularly because I think it would be better for them to get a different view point, and partly because of the multiplicity of duties that fall upon the entomologist, and really make it impossible for him to give a good postgraduate course, so that I have not had a single postgraduate student, and am not looking for any. I have not turned out more than one or two men that have followed entomology, and that have made a success of it. I do not consider myself a failure as a teacher, because I have turned out a good many other men who have done good work, and whom I meet occasionally, and who remember the instruction received from me. Now there is one point that was not brought out, except in a very incidental way, and I think possibly Professor Bruner referred to it, and that is, that in the course of laboratory work a teacher can do an enormous amount of teaching while watching the boys in their work, talking to them and telling about the relation of the insects to other subjects, and doing it without the formality that a lecture implies, and then suggesting to them that in making their notes they also incorporate as much as possible of what has been told them. Their own work is always easily separable from what they remember having been told. I have been extremely interested in the papers, and yet not a single one has touched the case as it lies in my own institution, and where, as I think it may be possible in other institutions, we are not able to take the students out for field work. Naturally the situation of an institution has a great deal to do with the manner in which the natural sciences are taught, and especially so in entomology. We have always plenty of material to work with, but it is mostly material that has been collected for the students, and they have very little opportunity of going into the field, although they get some chance in my department and in the horticultural department to do practical work in spraying. I follow Professor Bruner's suggestion in that respect and turn over to the Horticultural Department a good deal of the practical work of spraying.

Secretary Burgess: I wish to say in regard to arranging for the symposium, that I asked Dr. Bethune and Dr. Wheeler to take part. Dr. Bethune wrote that he could not be here on account of the fact that it was necessary for him to submit to an operation at this time, and Dr. Wheeler, I believe, is away on his vacation. It might be interesting to note that the arrangement of Harvard postgraduate work in entomology is to have the session last through the summer,

and the vacation in the winter. Professor Kellogg wrote that he could not be present, but at that time said he could send some remarks, but I have not received them. Dr. Forbes wrote that he might be here.

President Sanderson: I am very much interested in this discussion, but it struck me that the papers were all dealing in the preparation of the entomologist. Now, I think most of us have to deal with the preparation of the farmer and the fruit grower generally, and there are only a few of us who have the privilege of training up entomologists. I take it that the teaching of entomology is just as important for the masses, as it is to train up the few who are going to be the workers, and I wish we might have discussion on that phase of the subject. For instance, how are we going to teach these men, like Professor Osborn has mentioned, these two-year men, the kind of men we find in the School of Agriculture? We are getting an increasing number of this class of men. What sort of work is given in entomology? How do you get them, for instance, familiar with the plum curculio, and the various other forms of injurious insects? Do you merely tell them about them, and show them a lantern slide? Do you discuss a family of insects, and have a case of specimens, which you put on your table and invite your students to look at? Now these are some of the things that have occurred to me. How do you do field work in the winter—your school classes begin the first of October, and you get out the first of June? Should entomology be required in all agricultural courses? Many would say "yes," many "no," and yet how many say they took the course, not because they did not know much about it, but because it was a snap, for they got the same pedagogical value from it as from some other course? Then, another thing, is the systematic work; is it of any real value to a man, and is it taught in such a way that it will be of value to him? If any of you want any suggestions along this line, if you ever get a chance, talk to Professor Lochhead of Canada. His idea of entomology is of teaching it just hind side to; of starting by giving the students the economic phases, and then taking them out into the orchard and saying, "Is this insect beneficial or injurious; how are you going to tell?" It then occurs to them that systematic entomology has some application. I have tried to interest a class of students who have no idea of going into entomology. How can one give those men a training that will be of any practical value to them? I believe if we went so far as to make elective economic entomology, it might not be a mistake.

Mr. J. B. Smith: We have a short course at our institution, and it is really a short course, only lasts thirteen weeks, and I give a series

of lectures. An assistant does work with the students one hour in the morning, and four afternoon hours in the divided classes, so that every student gets a little information early in the period. Every one of the questions the president has asked has come to me, and at the same time I do not make the slightest effort to teach systematic entomology, beyond the teaching of orders; but what I do undertake is to teach how to tell the difference between an injurious insect and one that is not injurious, or between one that can do a certain kind of damage, and one that can do another kind. And then, in regard to another matter that was brought up, and that is, how do the men recognize these insects. I make it a point to have collected during each season, as many of the common injurious insects as it is possible to get hold of. Of course, we cannot get all the injurious insects, but we can secure plenty of plum curculio, plenty of bark borers, and plenty of the work of these insects, even if it is necessary to bring in the trunk of a whole tree that they may see the actual work, and they are expected to do some practical work. I think we can do a good deal of teaching, even in a short time, in this way.

Mr. Rogers: The question of using charts and lantern slides to present beautiful pictures may not be the best way of teaching. I know a teacher who, in his books, has some very fine diagramatic illustrations, and prior to the time we would go into the room we were expected to draw these exactly. Now it struck me that was not the best way of presenting a subject. Personally I am poor at drawing, but I would rather draw one part, and extend that to another until finally I had made the whole diagram, as requiring less effort than some other form of study, but it would be good training if the student applied it in entomology. Now, there was another point brought out, and about which I talked with Mr. Headlee here, and that is, teaching a certain subject back end to. I found that I had a little more work than I could handle, and in teaching physiology it occurred to me that I was not teaching anatomy just right, that instead of going over all the bones of the body, then finally the muscles uniting them, and so the whole frame, I would take just the trunk, and then the ligaments and then the bones. The main object I had in view, was that the student had to obtain certain ideas when he was in school. I never supposed when I was gathering Vermes and Arthropoda that it would ever be up to me to teach the subject, so I thought it was better to proceed in zoölogy with a definite study of one species, and learn that thoroughly. I note that some of the discussions here suggest preceding the study of entomology by zoölogy.

Mr. Gossard: I should like very much to hear from Professors Washburn and Summers on this subject.

Mr. Summers: I am not so modest as Professor Washburn, so will talk before he does. I am out of the teaching of entomology, almost, to my great regret, and I can only say a word or two about one or two special problems at this moment. One special problem that I have at present is to arrange a very brief course required in entomology for certain agricultural students who have had insufficient preparation in general zoölogy, a course that is not at all worthy of a place in any institution, that is, one fit for the college student; the short course student takes but a thirteen weeks' course. Now, what we will do in the case of the student who comes to us with no preparation in general zoölogy, and to whom we are to give instruction for a single semester in entomology, is really my great problem. I have a strong feeling in connection with our courses in entomology, that we ought either to demand sufficient time to give a respectable course to students who take up that work, or that we ought to refuse to teach it at all; and I have done so the present year. Within three hours of taking the train to come to this meeting—I refused to teach a course in my department that was to have only partial time for one semester, in which I was expected to give training to forestry students in forest entomology—no general zoölogy, no general entomology. I think the reasons for that hardly need explaining.

Mr. Washburn: I think Professor Summers hit the nail on the head when he refused to give instruction on such meager general knowledge. Now, Mr. Chairman, I approach this subject from a different point of view from that taken by any one else, and I think Mr. Gossard may be a little disappointed in what I have to say. From the nature of my position, my ambition is to do the very best economic work possible, and to do that, we need in Minnesota, as we all need, trained men. We have great difficulty in finding men of experience to take positions of responsibility in this line. What is the reason? I can only answer for my own institution. I do not think the Board of Regents appreciates the importance of entomology, practical entomology, or any entomology. I do not know whether that is the case in other institutions, but that is our difficulty, and I should like to see more entomology put in, and I want to get a chance at the boys when they first come into the college, so that they may learn for themselves whether they like entomology or not. Now, I have drawn a resolution, Mr. Chairman, which it will do no harm, I am sure, to present at this time. It might be helpful to some of us, and certainly could not harm us, though Dr. Smith and Professor Summers might not agree with me.

President Sanderson: There would be no objection to the

presentation of the resolution at this time. It might be read at this time and considered tomorrow.

Mr. Washburn: In view of the increasing demand for trained entomologists, and the lack of properly qualified men to fill these positions, it is hereby resolved by the Entomological Society of America, and the American Association of Economic Entomologists, in joint meeting, that boards of regents in universities and agricultural colleges be urged to give all possible teaching in this practical subject, both in undergraduate and graduate work.

Mr. J. B. Smith: I have no objection to this.

President Sanderson: It might not be a bad idea to refer this matter to the committee on resolutions, Messrs. Headlée, Sanders and Symons.

Mr. Symons: Mr. Chairman, as we will not have a chance to take this matter up again, I should like to say a few words in regard to the future outlook. Certainly if the work is left undone, as suggested by Dr. Smith and Professor Summers, and you get out of it by not giving the proper courses, I think you will find that other departments in the institution will take up the time you have had for teaching. In other words, if you do not push the work, and demand a certain time for it, is there not going to come a time when there will be very little teaching of entomology in your agricultural colleges and universities. I might say I have had some very hard work in Maryland. We had a very limited course, and I maintained that the course was not sufficient, and felt justified in endeavoring to increase it; and during the last two or three years we have increased our courses from, I believe, about four to twenty, and the only regret I have is that I cannot impress upon the president the fact that he should appropriate more money for doing this work.

Mr. J. B. Smith: You have increased from four to twenty what?

Mr. Symons: Courses in entomology. We have two-week, ten-week, two-year in horticulture and agriculture, and regular four-year students, and in this regard I would say we have time to get the boys when they first come to college, and introduce the work into the preparatory courses. I have recently revised the curriculum and raised the standard, and in doing that was able to get in more time for entomology and zoölogy. When I said twenty courses, I referred to both entomology and zoölogy. We have had excellent results with the "preps" and freshmen in taking practical work, and it certainly seems very desirable to give them practical work in elementary courses that will establish their interest in zoölogical work; but as I say, I am confronted with the question of securing sufficient money to carry on these courses properly without making it embarrassing to

my state fund. Another question arises in regard to the amount of instruction given in the public schools of our states. How many public schools of this country are teaching entomology? I firmly believe all of them should be teaching it in an elementary way. It could be taught much easier than many other subjects, it seems to me.

MR. S. J. HUNTER: I have been very much interested in the discussion this afternoon, because it has presented a phase of the subject that I am not familiar with from experience, because in Kansas we have no short courses. I take it for granted that it was intended that each should say something about his own institution in regard to the work done. I think every one of us has been impressed with the students' change of attitude toward the institution from the day he begins, when the thing is "a bug," and the day he leaves with a proper view of life. At the University of Kansas we require zoölogy for entrance. Entomology we do not absolutely require, but we see that the student takes it before passing out of the course. We endeavor to make entomology a two-year course, taking the man in the sophomore year; the first year, three days a week is given to two hours' laboratory work, two days a week to systematic study through the year, at the close of which we expect the student to be familiar with all the common forms as far as the family. The next year he gets more of the same, but we have no special work students until the graduate year. We insist upon the first year's work being as intensive as possible. Of course, we recognize the fact that many of our students do not go on with entomology.

MR. SWENK: Regarding the instruction in entomology, and the advisability of such a course in a secondary school: in Nebraska we have three courses, the summer school,—the School of Agriculture offers four years,—and a six weeks' course in the winter, known as the winter course. Now, as an answer to the question as to whether entomology has a place as a required subject, I would say that the competition for a place as a required course in the four-year course is quite keen at our institution, and the law of the "survival of the fittest" has not ceased to operate. In this course if we were not giving practical instruction it would, in all likelihood, be dropped, because the subject is not a prime favorite. Now, the method of teaching, as employed at this institution, is, as Professor Bruner says, one that simply evolved during the past eight or nine years. It has been changed in different points from year to year, especially during the latter years, and as we are presenting it at the present time it seems to give some measure of success. Still, we find the work must be made exceedingly elementary. These boys come to the school, many of them, very green, and with very insufficient preparation,

and what they want is the most practical instruction. About 90% of the boys return to the farm at once, and of the 10% which continue, the most of these go on in the College of Agriculture and specialize in various lines, fitting themselves for experiment stations and other positions, and so the problem concerning us is to implant in the men something that will be of value to them. We start in the four-year course with the men, which is the most important of the three, by trying to give every student a good foundation. We give them some idea of the transformations of insects, and something of biology, and something of classification, but we do not give this instruction in the terms I would use to you. We make it perfectly simple, and illustrate it as far as possible. We make much use of demonstration materials in the class room, and that, up to this time, has taken the place of laboratory work. We then take up the study of orders. We do not use technical names any more than necessary. Our object is to give a general idea of the different types of insects, and something of the relationship of the different forms, something of the life history. This takes up the winter semester, and is considered the ground work. At the end of this the work changes radically, we turn about and face the practical side of the problem as intensively as possible. We take up in succession the particular crop pests of our own section, beginning with the chinch bug, the Hessian fly, wire worms, corn worms, etc., taking these in turn and giving an idea of the appearance of the insect, so that the student can see the importance of the study. In these demonstrations some Riker mounts are employed, and others we have prepared, exhibiting the life history, cases showing the work and the insect in its varied stages. These are placed on exhibition, and sometimes we dismiss the class, so that each student can view the insects and their work. The student then gets a good idea of the pest. We then deal with the life history, but only so far as the life history involves methods of control. We try to show the student why we apply certain methods of control, and try to give the most practical information we can impart. The work with the women, perhaps, is not so pertinent here, but the first semester is practically the same; the second is devoted to household insects and human health. In the case of the short course, the subject is presented in an even less technical way—demonstration material and lantern slides—we do not decry the use of lantern slides. This is another way of placing before the students a concrete idea of the work in hand. As to the practical results of these methods I will say that many students, when they return to the farm, write in concerning certain pests, and the intelligence displayed in the questions asked indicates that the man has been a student in our institution, without

our having to refer back to our records. We are now about to undertake a rather important step. The work has been given in the freshman year, and we have found that while we have had some success, yet we feel we can do much better if we advance the work two years, giving it in the third year. So the work from now on will be given in the third year, and we are attempting to give some laboratory work with it, and that is exceedingly difficult to work out.

Mr. Sanders: I believe one of our greatest difficulties in teaching entomology is that we work from cause to effect, rather than from effect to cause. I have found in my work in Wisconsin that I can get the interest of fruit growers very much better by addressing them on the work of apple insects, and from that to the life history stage by stage, working from the injury to the insect. I have applied that method in my teaching to a large extent, and have taken the work from effect to cause. Another thing I thoroughly believe in is to divide and subdivide classes into small groups of six or eight, and to talk to them in a conversational tone, using lantern slides, if necessary. I believe personal contact with your men is far better than attempting to teach a large number in a lecture.

Professor Summers: I move we adjourn. Seconded. Carried.

Morning session, Thursday, December 29, 1910

Meeting called to order at 10.30 A. M., in Entomology Lecture Room, Main Building, Department of Agriculture, St. Anthony Park, Minn., by President Sanderson.

President Sanderson: The first thing on the program for this morning is the discussion of the presidential address. I will call Professor Summers to the chair again.

Mr. Summers (in the chair): Gentlemen, our presidential address is open for discussion. As I remember it,—it is such a long time since it was delivered,—he said something about preceding presidential addresses being deeper and of greater import. I think all of us here, without exception, will make an amendment to that, and strike out the reference to past addresses. The discussion is open.

Mr. Osborn: It is pretty hard to say which of the many strong points in the president's address impressed me most. There were a number of points which impressed me at the time, but several things have come up since to drive them out of my mind; but one, the matter of coöperation, it seems to me, is a very sensible idea. Now, as stated in that address, a number of years ago a committee attempted

to do something in that line. We then experienced difficulty in securing coöperation, and while the situation is perhaps somewhat better now, still there is a good deal of it with the work in each station, and the work in each state will be determined by that of the station. Some work does not permit of coöperation, though I think the general idea is practicable.

PROFESSOR WASHBURN: I think perhaps the thought may have occurred to some of us that the method suggested by Professor Sanderson might possibly make one less original. In other words, there would be a tendency to fall into the ways of others, and we would be very apt to adopt their ways and methods instead of originating something ourselves. It is undoubtedly a mighty good thing to know what other men are working on, but just how far we should go as to the interchange of methods I do not know. It seems to me each man must determine that for himself. It would appear that the Office of Experiment Stations has some pretty good reason for not giving out what their Adams Fund men are working on. I should be very glad to find some man who is working along the same line I am, though I should not like to see a system established by which we were obliged, or even advised to give out every bit of work before publication. That is purely a personal view.

MR. J. B. SMITH: This matter has been brought to my attention several times,—the idea of somebody else working along the same lines that I, myself, was working. I have no fear that it would hinder originality in any sense, but my experience has been that I should like to have my own results and conclusions checked up by somebody who was working along the same line under somewhat different conditions. I have frequently got bulletins in which an allusion was made to certain work, and upon reading them over I decided, "Well, now, that may be all right where that work was done, but it does not apply here." The insects that are counted of so much importance in that bulletin as to require treatment, are practically of no importance in our state, and it would be a waste of time and money if we were to treat them in the same way. I have sometimes felt that possibly I was doing work which I considered important and far reaching that, after all, might be only of local interest, and if I had some way of knowing what others were doing along that line, it would be of considerable help. Of course, the man who originates a new line of investigation who takes up a path that is a little different from that of others, likes to be credited with taking up that line of investigation, and I do not see why that is not possible. Suppose we find two or three men who are working on the plum curculio, to take a common insect. Now I might think a certain point had not

been sufficiently studied, or there was a new way of studying the problem, or the method of dealing with it. I might suggest that, with the understanding that whatever experiments were made along that line should be credited to me as making the suggestion. Let the man who does the work get all the credit for the work, but let him give due credit to the man who made the suggestion, and then if you publish in two or three states at approximately the same time it will be possible to tell just what importance is to be attributed to the suggestion, and the results will, of course, be of infinitely more value than if the line of work were carried on by one individual only. I think we ought not to go away without taking some steps toward putting the president's recommendation into a tangible shape.

Mr. Lowe: President Sanderson's address has been most inspiring to me, as I shall go back to my work with the possibility of not meeting another entomologist for a year, as I have done the past year. Touching the point which Professor Osborn raised, of coöperation, I think it is very desirable, but one that we would find difficult in our work. We are developing methods along a new line of work that we could not give out to many men to work on. We want accuracy of results, and in that respect I might refer to Mr. Washburn's remarks about the interchange between entomologists at work upon one line of investigation, and Dr. Headlee's paper on projects; all of which I feel are going to help me a good deal in my work. I thank President Sanderson particularly for his address.

Mr. Gossard: In talking with members upon this subject I am impressed with the idea that the great difficulty we have is in finding some workable plan by which we can know what others are doing. I do not believe it would interfere at all with the work, and so far as duplication is concerned, we might profit by it. Personally, it has seemed to me that duplication in publication upon some of the great problems of entomology was exceedingly desirable. We called attention to the point, when Dr. Headlee wrote us that we really had no satisfactory method for controlling the codling moth until it has been worked over by a number of men. We have to work those things out, each one in his own state. There are from one to a dozen other great entomological problems in which we would make great progress, and in which we would do more for the public good if we had some sort of team work. It has seemed to us that our great difficulty in advancing scientific entomology is this. We have a somewhat similar condition in what used to be known as "Agriculture." It was pretty generally agreed that it was a study which was sort of divided off into different departments, each having its work. It became scientific agriculture as the different departments worked

together, and it appears to me that except for the systematic part of it, economic entomology is very much in that condition. We recognize this in a way, and yet there is no classification, and a young worker cannot tell just who among the entomologists are interested in those things in which he is especially interested. Now, if we knew those entomologists who had taken chemistry, those who had taken pathology, and those who had taken horticulture or mechanics, and we had a method of classification,—it would have to be rough in the first place,—but it would enable any student to consult with the few who were interested in those themes in which he was interested, and would create a sort of division of economic entomology, in which there would be chemical economic entomology, the mechanical economic entomology, the horticultural, the pathological, etc., and it seems to me we could coöperate in that way better than we could by having a committee, and know, at least, just exactly what we were doing. I should feel considerable trepidation if I should undertake to tell some of the veterans what they ought to be doing, and I am quite certain that no committee would feel like fixing the lines as to what any man should be or should not be doing. It would be useful to have some such statement as Professor Headlee proposes each year, to see who is working on each problem.

MR. WASHBURN: We have no time for a debate, but at the same time I do not want to be misunderstood. I believe thoroughly in coöperation. I believe in knowing what each one is doing, it would forward the cause, but at the same time human nature is very much the same, and I think if some one, who perhaps is a little more original than others, should pursue certain methods in investigating the codling moth, for instance, we might, at least some of us, follow the same methods, because it is so easy to follow, and yet those methods might not be so good for our state as something we had thought of ourselves. At the same time, that does not oppose coöperation.

MR. R. L. WEBSTER: It seems to me the general idea of coöperation is a very good one to most of us. As it is, we have, in a way, divided the work, giving one man a problem in one state, and another man another. We really do not know much about an insect until we have seen it two or three years, and studied its life history, and our work must be largely independent. I believe as Professor Gossard says, we could get a great deal out of coöperation, but we must get in and dig. Regarding originality, I think it always shows itself in publications; there is always the stamp of it in entomological bulletins or articles. By looking them over you can see whether the author has really got in and worked out the facts, or if he has simply bor-

rowed from other publications. I would like to do some work in coöperation with other men.

Mr. Symons: I wish to express my appreciation of the president's address, and I wonder if it would be out of the way to suggest the appointment of a standing committee to carry out this idea, mentioned by Dr. Headlee, to start a system of uniform methods, which we could all agree to, as treatment against various pests. We have a standing committee which has done most excellent work in the suggestion of common names, and I wonder if we could not make a start on a uniform method in the treatment of some of our insect pests. For instance, it would not be out of the way for this Association to indorse the lime-sulphur treatment for San José scale. Anything that will tend to strengthen our position, it seems to me, will be advantageous. As was pointed out by President Sanderson in regard to the chemists, their methods are accepted by practically all official chemists, and it may be that we could make a start.

Mr. Hunter: I think that the president's address was one that looked far into the future. It deals with the problem that is before us, not only in our own line, but practically all lines. The question is whether the greatest advance in science is to be through coöperation or competition. It seems to me the important thing is the advancement of science rather than of any personal matter. Now, I think that one speaker spoke very well when he said there was a great difficulty in formulating plans. I think we all agree that plans, however thoroughly recognized, are of little avail unless the true spirit is evident. We have taken up the matter of coöperation in our own institution, in the past few years in larger degree than ever before, and, [illegible]g personally, I must say that it has not seemed a curb to indi-[illegible] or originality, but rather to stimulate it. For instance, in [illegible]m our department had under way, about completed now, [illegible]m was turned over to our department and the department [illegible]ology; another one was turned over to our department and that of biology, dealing with the external and internal features, and there are a number of problems in our state being worked out by our [illegible]ion, and all through the departments working together. It [illegible]n to me a personal stimulus to better and more thorough work, [illegible] am going away from this meeting with a deepened impression [illegible] unanimity of spirit manifest here.

[illegible]. Headlee: It has surely seemed to me that one of the greatest [illegible]ts that can come from the work of such a committee is the inspira-[illegible] that such a committee may give as the result of broad-gauged [illegible]ussion of the projects. It should get out a report which should [illegible]d, in respect to this work, much as the Carnegie reports stand in

respect to education—something that looks toward the future, something that holds up an ideal, something that influences men by directing them. This committee cannot command, and say you shall do this and the other thing. It can merely stand as an inspiration to us, and that is the kind of work I should like to see this committee do. It is the kind that would help me, and not for one moment do I believe that acquaintance with plans under consideration will reduce originality. It will form a basis of effort. One man will find out what another man is interested in, and he will look at that plan, and if it appears good to him he will adopt it. We are after the advancement of our science, rather than the advancement of the individual. There may be a minority of men in the country at large, I believe, who are firmly of the opinion that if their plans become known, they are so good and so desirable, that those of us that can will take up their ideas and work them out before they have finished. Now, the reason one party gave me for the office of experiment stations not divulging the plans of other entomologists was along this line. The office had refused to tell him the plans because certain entomologists were afraid their plans would be taken up and worked out by somebody else before their work was finished.

President Sanderson: If it is in order, I should like to make a remark. I appreciate very much the cordial expressions in regard to coöperation, and I might say in explanation that the idea of coöperation I intended to convey was that it was to be purely voluntary. My main idea was that we could further this work through greater publicity, and Dr. Headlee has expressed the idea very clearly. There is one other point—with all due deference to originality, and I think I do not want to do anything which would retard originality, I feel that we have sometimes suffered from over-originality. If all the chemists were working by individual methods, we would have a very sad state of affairs. Now take in entomology, as a matter of comparison, the results of the codling moth work, which we have alluded to previously. I would not say we must all work alike, but at least try to get together. And then, this matter of team work, which Professor Headlee has spoken of, I think any of you who have had anything to do with station work, will appreciate that fact. Team work is the coming thing. Some of the biggest men in the Department of Agriculture have done their best in team work, and yet we have men in every station who do not want to pull with the other fellow because they are afraid he will get ahead of them. We do not want to frustrate originality, but men must be brought to realize the importance of working together. If we have to put a horticulturist, a botanist, a chemist and an entomologist on a problem all together for the proper

working out of the problem, it must be done. What Dr. Headlee said in regard to some men holding up ideals along that line, and especially policies looking toward the future, was exactly what I had in mind.

(To be continued)

PROCEEDINGS OF THE NINTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF OFFICIAL HORTICULTURAL INSPECTORS

The Ninth Annual Meeting of the American Association of Official Horticultural Inspectors was held at Minneapolis, Minn., December 29–30, 1910.

For convenience, the business transacted at the meeting will be reported first, which will be followed by the papers and discussions.

PART I

The first session was held in the parlors of the Hotel Dykman. The meeting was called to order at 8 p. m., by President F. L. Washburn, with T. B. Symons as secretary. Among the inspectors present during the meeting were:

F. L. Washburn, St. Anthony Park, Minn.; J. B. Smith, New Brunswick, N. J.; H. E. Summers, Ames, Iowa; G. G. Atwood, Albany, N. Y.; N. E. Shaw, Columbus, Ohio; E. B. Engle, Harrisburgh, Pa.; E. A. Back, Blacksburg, Va.; T. J. Headlee, Manhattan, Kans.; S. J. Hunter, Lawrence, Kans.; C. E. Sanborn, Stillwater, Okla.; C. B. Waldron, Agricultural College, North Dakota; Lawrence Bruner, Lincoln, Neb.; J. G. Sanders, Madison, Wis.; T. D. Urbahns, Fort Collins, Col.; H. C. Brookins, Brookings, S. D.; F. T. Wiley, Urbana, Ill.; and T. B. Symons, College Park, Md.

The visitors present were:

A. F. Burgess, Melrose Highlands, Mass.; L. O. Howard, Washington, D. C.; E. D. Sanderson, Morgantown, W. Va.; M. H. Swenk, Lincoln, Neb.; G. D. Shafer, Agricultural College, Michigan; and H. A. Gossard, Columbus, Ohio.

Mr. G. G. Atwood, chairman, submitted the report of the committee on permanent organization. The following constitution and by-laws were adopted and a permanent organization formed:

CONSTITUTION

Article I

Name. This organization shall be known as the American Association of Official Horticultural Inspectors.

Article II

Object. The object of this Association is to promote Agriculture and Horticulture in the country at large by devising and securing the adoption and thorough enforcement of such laws as will secure to the grower stock as free as possible from insect enemies and plant diseases.

Further, it shall be the object of this Association to obtain more uniform standards of inspection in the various states.

Article III

Membership. The membership shall consist of active and associate members.

Article IV

Officers. The officers shall consist of a President, Vice-President, Secretary-Treasurer and Executive Committee.

Article V

Meetings. The regular meetings shall be held annually at such time and place as shall be designated by the Executive Committee.

Quorum. Seven members including President and Secretary, or their representatives, shall constitute a quorum.

Article VI

Amendments. The constitution can be amended by a majority of votes of all active members.

BY-LAWS

Article I

Active Members. Active members of this Association shall consist of the person or persons of each state, country or United States Department of Agriculture, under whose authority certificates of inspection are issued or their authorized representatives.

Associate Members. Associate Members shall consist of assistants and co-workers in official service.

Article II

President and Vice-President. The President and Vice-President shall be elected by ballot at each annual meeting and neither shall succeed himself. The President shall deliver an annual address on a subject relative to the interests of the Association.

Secretary-Treasurer. The Secretary-Treasurer shall be elected by ballot at a regular annual meeting for a term of three years and shall make reports of the proceedings of all meetings, and submit the same to the Executive Committee for publication. He shall submit an annual report of receipts and disbursements.

Executive Committee. The Executive Committee shall be composed of the officers and three active members, to be elected by ballot at the time and place of annual meetings; provide for publications of proceedings; examine the books of the Secretary-Treasurer and recommend candidates for membership.

Article III

Dues. The dues of active members shall be $2.00 per annum, and for associate members, $1.00 per annum.

Article IV

Nominating Committee. The Nominating Committee shall be chosen by the Chair at the opening session of the annual meeting, which committee shall nominate officers for the following year.

Article V

Limitations. Only active members of the Association *or their properly accredited representatives* shall be permitted to vote for the amendments of the constitution or by-laws or for the election of officers.

Article VI

Amendments. These by-laws can be amended at any regular meeting by a two-thirds vote of the active members present.

Mr. T. B. Symons, chairman, submitted the report of the committee on affiliation. The report was received and the committee continued.

The secretary read a communication from Dr. T. J. Headlee, secretary of the meeting of inspectors from four states that met at Fort Smith, Ark., December 15, 1910, submitting a memoranda of the action taken by these inspectors at this meeting.

The following resolution offered by Dr. J. B. Smith was carried:

Moved: That the secretary be instructed to advise the secretary of the meeting at Fort Smith, Ark., of the cordial concurrence of this Association in the views and objects expressed in their communication. That he forward to such secretary a copy of the constitution and by-laws just adopted and invite the membership of the states represented at that meeting in our association.

By motion the president was authorized to appoint a committee on nominations and resolutions. The chair appointed Messrs. J. B. Smith, H. E. Summers and T. B. Symons to serve on both committees.

Further business was taken up at the last session as follows:

T. B. Symons, chairman of the committee on national legislation, made a report of progress and suggested that the Association endorse the Simmons Bill, providing for national inspection of imported plants, etc., before Congress. Dr. L. O. Howard explained the present status of the bill, and Dr. J. B. Smith read extracts from an excellent paper by Dr. Marlatt on "History of Such Legislation."

By motion the report was received and committee continued, and authorized to expend such funds as necessary, not to exceed $25 in promoting such legislation. The members of this committee are T. B. Symons, E. L. Worsham, and G. G. Atwood.

Report of Nominating Committee

The committee submitted the following report, which was read by President Washburn:

President, Franklin Sherman, Jr., Raleigh, N. C.; Vice-President, T. J. Headlee, Manhattan, Kan.; Secretary-Treasurer, T. B. Symons, College Park, Md. Three members of executive committee, J. B. Smith, New Brunswick, N. J.; H. T. Fernald, Amherst, Mass.; and J. W. Jeffrey, Sacramento, Cal

Signed

J. B. SMITH,
H. E. SUMMERS,
T. B. SYMONS,
Committee.

By motion the report was adopted.

The following resolutions were adopted:

Resolved, That this Association heartily endorses the Simmons Bill, now before Congress, in all its points, and urges upon its members the importance of advising the senators and representatives of the need of this legislation for the protection of the agricultural and horticultural interests of the country at large.

Resolved, That the thanks of the Association be expressed to the authorities of the University of Minnesota and of the Agricultural College for the courtesies extended to it during our meeting.

PART II

President F. L. Washburn made an address at the first session of the Association. [Withdrawn from publication.—ED.]

NEW YORK NURSERY INSPECTION

By G. G. ATWOOD, *Albany, N. Y.*

Inspection of nurseries for the purpose of certification was first provided for by act of legislature in 1898; $10,000 was appropriated. The Commissioner of Agriculture under the Agricultural Law was the enforcing officer, and he began the work with four inspectors. Two of them are still employed, and two have sought more congenial and profitable occupation.

The following five or six years of our work showed that the scale was continually turning up in the most startling manner and in the most unexpected places. More inspectors were put to work and the nursery centers were, throughout the year, kept under the surveillance of our inspectors. Notwithstanding thousands of nursery trees were sacrificed by rows and blocks, we had the hearty support of our nurserymen who united on the idea that nursery stock should not carry or breed scale. They stood the losses without state aid, and became so friendly that their constant demands for inspection placed no little burden on our men.

On Long Island, where the scale had become established in the highways and hedges, before our inspection law was enacted, the nurserymen have practically given up growing trees and plants on which the scale thrives. The custom of raising trees in nursery rows to bearing age in the eastern part of the state, and the methods of making "hospital" out of all good trees left over after packing in the western part of the state, were both abandoned. Thus a fertile source of continued infestation was eliminated.

We do not claim that all of our nurseries have always been free from scale one year or another, but we have a well-founded belief that they, at the present time, are practically free and under sufficient control so that practically no live scales are shipped. The records of the past year would not prove one per cent. of our shipments infested. Our nurserymen generally reject trees showing scale marks, though no live scales can be found upon the trees.

We have one nursery center in the state embracing nearly 1,000 acres of growing trees (over 20,000,000) where scale has never been found. The methods of this community and the care of the nurserymen are the principal reasons for the immunity. They rarely buy trees or buds from outside their Association's influence, and when their blocks mature they are sold from and the residue burned. Other nurserymen are mastering the problem by great care in making their purchases, in selecting their buds and scions and fumigating them. Our inspectors have been constantly giving attention to the surroundings of all nursery plantings in the state and, where necessary to protect the nursery, a thorough cleaning up or destruction of infested trees is insisted upon.

If infested trees are found in a nursery of growing stock between May and September they are at once dug and destroyed. If discovered early in the season several inspections are made and no certificate is issued unless we are positive that no infested trees are present on the date of the certificate.

All nursery stock growing within one half mile of a San José Scale infestation, whether on the nurserymen's premises or otherwise, must be fumigated. The fumigating houses or rooms are tested annually, the cubic feet computed and the material for the one-ounce formula given to the owners.

My story of nursery inspection in New York would not be complete without mentioning the very great results of that feature of our law requiring inspection at points of destination of all shipments into the state. This is so important that we wish to urgently recommend the adoption of the plan in other states. Under this division

of our inspection work we were fortunate in discovering and destroying over 7,000 nests of brown-tail moths coming in on nursery stock from abroad in the spring of 1909, and half as many more in 1910.

We also discovered on domestic shipments both brown-tail nests and gypsy moth eggs, and up to the present time believe that neither of these pests have become established in our state. This fall we found cast skins of gypsy moth on azaleas from Belgium.

By careful inspection of all shipments arriving we have found nursery stock that had to be rejected, otherwise it would have been mingled with our own and possibly have been shipped again under and to the disparagement of our certificate of inspection, a high character for which we wish to attain.

It has been the custom of our office for years to notify inspectors of other states, whenever we had reports of the receipt of infested stock —even when the number of trees was insignificant. Our reason for this is that by reporting our findings, and giving names of varieties infested, it would enable interested inspectors to trace back to possibly an unknown origin. Never have reports been sent to our brother inspectors with the intention or implication that in any way they were blamed or subject to criticism. Inspection for San José scale is not yet an exact science, and supervising inspectors live in glass houses. No restrictions of any kind are made, not even a requirement that shipments into the state must bear a certificate of inspection or fumigation, but the fact that all importations are subject to inspection at destination is becoming known, and the number of infested and diseased trees received is growing less and less. Nurserymen are more careful than formerly, and we all know that the inspection officers of the several states are improving their methods with better appropriations and experienced men.

976 certificates of inspection were issued in 1910.
463 to regular nurserymen.
44 to small fruit growers.
50 to vineyardists.
326 box inspections.
10 special stock.
83 special fumigation certificates.

There were also issued 407 duplicate certificates for shippers to file with the authorities of other states.

The total number of foreign and domestic shipments into the state in 1910 exceeds 6,500, about 1,000 more than in 1909 when there were 234 car loads, 12,149 boxes and 1,630 bales embracing over 4,000,000 trees and plants, and over 10,000,000 seedlings.

We learn of shipments into the state in various ways. The law

requires custom house brokers to register and to report shipments. Transportation companies also report required facts, and all persons bringing in stock are expected to report to the department. We keep a man at the New York City custom house to copy manifests. The collectors of customs in the state also advise us of importations, and Dr. Howard at Washington advises us of many lots.

Our inspectors are all under pressure during the shipping season, and during their travels they occasionally find a shipment not reported, but the number of such is not over 2% of the total.

There are about 121 custom house brokers in New York and nearly 30 transportation companies reporting to us.

We have 15 inspectors and 10 assistants who are employed throughout the year. Nursery inspection work has broadened considerably and our activities increase.

The nurseries embrace 11,000 acres and contain 110,000,000 trees and plants of which 33,000 plants have been burned because of scale. When the nurseries are cared for, some attention is given to inspection of orchards.

2,500 orchards containing one and one-quarter millions of trees were inspected in 1909.

35,000 trees were ordered sprayed for scale.

12,500 trees were destroyed because of peach diseases.

1,250 trees were cut for black knot.

We have 60 square miles in a peach belt where we cut 4.5% of the trees in 1904. We are working on the theory that by constantly cutting out Yellows and little peach diseases each year, that they can be controlled with slight loss. It would seem that the plan gives strong evidence of success, for in last year's inspection about .9 of 1% had to be destroyed.

Another field of our work for the past two years has been the inspection of several hundred thousands of white pine seedlings planted in the state for reforesting.

In the spring of 1909 it was found that the Forest, Fish and Game Commission, and some private parties, had imported from northern Germany a large number of white pine seedlings, among which the blister rust was found generally distributed. Full information on this subject was given in a bulletin.

This last summer it was deemed necessary to reinspect all the plantings and destroy all infected trees, and also search for and burn all plants of the Ribes within, and adjoining, the plantations.

The alarm caused by our discovery of brown-tail and gypsy moths coming in on nursery stock and on evergreens to be used for decorations, awakened all the efforts of our inspection force. Our commis-

sioner has determined that neither of these pests shall become established in the state during his administration, and we have exhausted every precaution that seems feasible. We have for years kept watch of the highways and rail tracks leading into New York from the moth infested areas of New England, but in order to be informed on the best method of scouting, we asked for and secured from the Massachusetts authorities two of their best men who spent a month each in the state accompanied by several of our own inspectors. Seven of our own inspectors were sent for a few days to Massachusetts. By the courtesy of Mr. D. M. Rogers, Special Field Agent, of the United States Department of Agriculture and under the guidance of Mr. L. H. Worthley, Assistant State Forester in charge of Moth Work in Massachusetts, they were permitted to study in the field of operations the whole subject of moth control. We also sent two of our young active and clear-sighted men to work a month in Massachusetts during the moth season to acquire information. All of these actions were taken to prepare us for the contest which sooner or later may come upon us. We want to prevent the fight as long as possible, and at the same time be prepared for the inevitable.

Our inspectors are also called upon to collect official samples of insecticides and fungicides sold upon the markets of the state under a section of the law, which provides also for certificates under certain conditions issued to manufacturers and dealers. Two hundred and fifty-one of these certificates were issued in 1910.

We also have the enforcement of the law relative to apple packing and the use of barrels of standard size for the sale of apples, pears and quinces.

President Washburn: We shall be very glad to hear discussions upon this paper.

Mr. Waldron: I should like to ask how many points of destination you have. You speak of inspection at points of destination; does that apply to foreign stock entirely?

Mr. Atwood: We have hundreds of points of destination—whereever boxes are opened at the nurserymen's grounds or where plantings are made.

Mr. Waldron: In our state, for instance, where a great many shipments consisting of but a dozen apple trees, or a half a dozen cherries, and a few rose bushes, shipped from somewhere down in Iowa into North Dakota away up from the state line, it would be impracticable to inspect such boxes, and almost impossible.

Mr. Atwood: We do not have to go as far in New York, but we spend a good deal of time chasing up these shipments.

MR. WALDRON: These shipments come from nurseries that bear certificates of inspection in Iowa, Minnesota and other states, and their inspection ought to be as thorough as ours. It would be an endless task, almost, to inspect all those shipments.

MR. ATWOOD: I thought it might be a good plan to have a point of entry where inspection could be made, but I doubt whether it would be possible to get authority to do it. The movement of nursery stock in interstate business, contemplates the delivery of that stock at the point of final destination, and there is no power that can stop or open an interstate package in transit. If any state wants to ship stock into New York, it can do so. The stock must be certified, when it gets into the state, then the state has control of it.

MR. SANDERSON: I would like to ask if there is any systematizing of that inspection. As soon as you get notice of the arrival of a shipment at destination, do you immediately send a man to inspect, or do you hold it there until you have several shipments that can be taken care of on one trip? Also, what is the approximate cost of such inspection.

MR. ATWOOD: We have several men distributed over the state, and two or three men at large nursery centers, such as Rochester, Geneva, Dansville, and down the river. Two or more men are available for these shipments, and the commissioner has authority under the law to order shipments held until an inspector is present, that enables us to look after things known to be suspicious. The expense of looking up shipments I could only give approximately. We have about thirty thousand dollars for our regular inspection work, and we have a special appropriation of fifty thousand dollars available this last year for an emergency, to provide against gypsy and brown-tail moths, or anything else, and I suppose the examination of six or seven thousand shipments would cost about ten thousand dollars.

MR. SANDERSON: Does that include the salaries of the men engaged in the examination?

MR. ATWOOD: Yes.

MR. SUMMERS: I was interested in one remark of the gentleman on my left regarding the small shipments, trivial almost in numbers of plants, which had already been inspected, and I want to say that I know of only two cases in which trees actually grown in Iowa have been found in other states to bear living scale. One of the two cases was an infestation of three trees which went into New York, and as I remember it, the whole shipment was only a hundred trees.

PRESIDENT WASHBURN: Mr. Summers, are you finding much San José scale?

MR. SUMMERS: We have a considerable amount of it in the southwestern part of the state. I think I reported five or six cases of it, but

it was under circumstances where it was completely eliminated, at least, it has not since appeared, but we have a good deal of it in orchards in the southwestern part of the state at the present time.

SECRETARY SYMONS: I consider the matter of inspecting shipments from other states very important, and one which I think every state should adopt. In the past two years I have made it a requirement, and wish it so understood by all nurserymen shipping stock into Maryland, that I intend inspecting the stock, and require from them a statement of all shipments. No matter how careful an inspector is, there will be some cases, on the part of unscupulous nurserymen, of unloading such stock, and I think that each state should have a law requiring all nurserymen to submit statements.

MR. SUMMERS: In states having little money, this may help in giving the impression among nurserymen that stock is very likely to be inspected. There is a case in the courts of Iowa that is interesting me: A nurseryman shipped in stock from another state, bearing the certificate of that state. The consignee refused to pay for it, partly, he said, because the stock was very poor in general character, but his defense in court has been that the stock did not bear a certificate which had been approved by the state entomologist of Iowa, as the Iowa law required. I should say that three-fourths of the nurserymen doing business in Iowa do not file in Iowa copies of their certificates, as required by law, and I have no means at present of enforcing that requirement; nevertheless, that requirement is printed by other states on their notices, and from some states I think I have received duplicates from nearly all the nurserymen. At present the only advantage is that it gives aid in court, the decision of the present case, which is in the circuit court at Sioux City, will show how valuable that is.

EDITOR'S NOTE.—Contributors doubtless appreciate in some measure at least, that exigencies of the makeup must determine to a certain extent the matter included in each number. An unusually large amount of copy was received from the secretaries of the Association of Economic Entomologists and also the Horticultural Inspectors. Practical consideration, not to mention the fact that this serial is the official organ of the first named organization, has rendered it advisable to include in this number more than the customary amount of matter. This has necessitated the holding of some papers already in type for a later issue. The editor would in self-justification call attention to the fact that he gave for all of this only a conditional promise of publication in February. We would emphasize once more the desirability of sending in brief observations which may be published in a separate department as scientific notes or used here and there as fillers. The editor should not be expected to supply all such matter.

President Washburn: The next paper will be on "European Conditions in 1910 and General Inspection Prospects," by Dr. L. O. Howard of Washington.

REMARKS ON INSPECTION AND SOME CONSIDERATION OF EUROPEAN CONDITIONS IN 1910

By L. O. Howard

(Author's Abstract)

The speaker described the establishment of an inspection service in Belgium, and gave the details concerning the recently established inspection service of nursery stock intended for foreign shipment in France, the details of which are given in the Journal of Economic Entomology for December, 1909, 3: 499–502. He also recounted his experiences in the nursery-growing regions of France in June, 1910, showing that in the very localities where the gypsy moth and the brown-tail moth had been unusually abundant in the summer of 1909, practically none were to be found at the corresponding period in the summer of 1910. No gypsy moths and no brown-tail moths were to be found in any of the great nursery-growing regions of Orleans, Angers and Ussy. This he stated is an encouraging condition of affairs for those who have to inspect imported stock in this country during the coming winter, but it by no means indicates that rigidity of inspection should be lessened.

The speaker gave an account of the hearings on the Simmons Bill held in the spring of 1910, and stated that the bill had been reintroduced, and that an effort will be made to secure its passage during the coming session. He indicated that the opposition of the Legislative Committee of the National Nurserymen's Association centered on section 8 of the Simmons Bill, which gives the Secretary of Agriculture power to quarantine against any section of a foreign country in which there has been shown to exist in dangerous quantity insects or plant diseases, new to the United States. He stated that in his opinion should the bill become a law without this section, it would be very much better than no quarantine or inspection bill at all, but that in the opinion of the phytopathologists, especially, the section in question, is one of great importance.

Other general features of the situation were referred to.

[Extracts were then read from the following paper, which in view of the great practical importance of the subject, is published in full.—Ed.]

NEED OF NATIONAL CONTROL OF IMPORTED NURSERY STOCK[1]

By C. L. MARLATT, *Bu. Ent., U. S. Dept. Agric., Washington, D. C.*

The need of national quarantine legislation for the protection of the fruit and forest interests of this country from the accidental introduction of new and dangerous insect enemies or plant diseases on imported nursery stock or other living vegetable products has been long appreciated, and requires no argument.

The United States is practically the only one of the great nations of the world which is without legislation protecting it in this particular. The considerable lessening of yield and higher cost of production of many important staples, particularly fruits, is directly chargeable, in large measure, to the lack of such protective legislation in the past, as will be shown by a number of illustrations to be subsequently given. Furthermore, there is now an increased risk in this country over that normally existing by the introduction of foreign stock without inspection or other means of safeguarding, in that the protection which other countries have from proper legislation naturally results in this country being made the dumping ground for refuse and inferior stock. This state of affairs was brought out strongly by Dr. J. B. Smith, entomologist of the State of New Jersey, in his testimony before the House Committee on Agriculture at the last session of Congress. In his testimony Dr. Smith described the importation by large department stores of New York and Philadelphia of a mixture of inferior stock of fruit and ornamental plants massed down in large boxes, thousands of plants in a single case. This largely worthless, and often infested stock, is being distributed by these agencies either at a very low price or as gifts to customers, and goes in small parcels here and there where it cannot be followed, and necessarily entails the greatest risk of introduction of dangerous pests or plant diseases.

The regular importing nurserymen endeavor to get, and do normally get, good stock, which generally arrives in fair condition; but often such stock, as will be shown later, carries with it the gravest risk of introducing dangerous plant enemies.

The only important port of this country that has a plant quarantine service is San Francisco. There, for the last twenty years, a

[1]This paper is a reprint of one submitted to the House Committee on Agriculture, and published with the report of that committee, recommending the pending quarantine bill (Report No. 1858).

competent inspection of foreign nursery stock and fruits has been maintained by the state authorities. In a single year the quarantine officer of San Francisco destroyed over three thousand trees and plants infested with insects new to California, and much other stock has been thoroughly fumigated before it has been admitted. During these twenty years a great many dangerous importations of insects and diseases have been detected and stopped at the port of San Francisco, to the enormous gain of the fruit interests of California and, indirectly, of the whole country.

FOREIGN ORIGIN OF MANY OF OUR INSECT PESTS

Fully fifty per cent. of the important injurious insect pests in this country are of foreign origin. Among these are the codling moth, the Hessian fly, the asparagus beetles, the hop-plant louse, the cabbage worm, the wheat-plant louse, oyster-shell bark louse, pea weevil, the croton bug, the angoumois grain moth, and the horn fly of cattle, and, in comparatively recent years, such very important pests as the cotton boll weevil, the San José scale, and the gypsy and brown-tail moths. Many, if not all, of these pests, and others not mentioned, could have been kept out or their spread much checked if proper quarantine legislation had been available, and the saving to this country would have been enormous.

While it is true that certain classes of injurious insect pests, such as the house fly and other household insects, and other insects which may be similarly carried in ships' cargoes or in the packing of merchandise, have been imported, and still will be, in spite of any quarantine law, however rigid; it is equally true that the great mass of the foreign insect enemies of orchards and forests have come in on nursery and ornamental stock, and might have been kept out, in large measure, if an efficient quarantine law had been in operation.

Taking up a few of the insects just mentioned, the codling moth now costs, in loss and cost of treatment of trees, $16,000,000 annually; the San José scale, similarly in loss and cost of treatment of trees, $10,000,000 a year; the Hessian fly probably causes an annual loss of $50,000,000, and in some years this loss has reached the enormous total of $100,000,000. The loss chargeable to the boll weevil, from the very conservative estimate of Mr. W. D. Hunter, amounts to about $25,000,000 a year.

The gypsy moth and brown-tail moth in Massachusetts and portions of other New England States are now costing those states, in expenditures merely in efforts at control, not counting damage at all, upward of a million dollars a year. In addition to this, the National Government is appropriating $300,000 a year to aid in controlling

these pests along the highways, and by this means check their more rapid distribution. In spite of these efforts and this enormous expenditure, these insects are still slowly spreading, and great damage is done yearly to woodlands, private grounds, and orchards. The dissemination of these two pests over the whole United States, as is extremely likely under present conditions, would entail a like cost throughout the country—a tremendous and unnecessary charge on our fruit and forest interests.

Very careful estimates, based on crop reports and actual insect damage over a series of years, show that the loss due to insect pests of farm products, including fruits and live stock, now reaches the almost inconceivable total of $1,000,000,000 annually. The larger percentage of this loss is due to imported insect pests, and much of it undoubtedly would have been saved if this country had early enacted proper quarantine and inspection laws.

DANGER OF ADDITIONAL IMPORTATIONS OF PESTS NEW TO THE UNITED STATES

Great as is the number of foreign insect pests already imported and established in the United States, there remain many others with equal capacity for harm which fortunately have not yet reached our shores or crossed our borders or at most have infested only a limited part of our domain. The prominent examples of locally established pests, the general spread of which should be controlled to the utmost, are the gypsy and brown-tail moths.

Our increasing business relations with China and other Oriental countries adds enormously to the risk of the importation of new pests. We know very little of the injurious insect pests of those countries, and particularly of China, but the importation of new stock in the last year or two, from China especially, has demonstrated the existence there of many pests which have not hitherto been known. The power of harm of these new pests is abundantly illustrated by the San José scale which is one of the earliest of the Chinese insect pests to reach us, and undoubtedly came to this country with some ornamental nursery stock sent from north China.

Among the known foreign insect fruit pests which it is very desirable to keep out of this country are the Morellos fruit worm, which is an important enemy of citrus fruits in certain parts of Mexico; the olive fruit worm, which occurs throughout the Mediterranean countries where the olive is grown; the mango seed weevil, which has been found in imported mango seed during the present year; several fruit scale pests known to occur in China, Japan and other Oriental countries, which have records for harm quite as great as the San José

scale; the gypsy and brown-tail moths to regions in this country where they do not now occur; and many other equally dangerous insect enemies of fruit trees, forest trees and farm crops known to occur in foreign countries.[1]

In addition to the danger of importing these insect pests is the risk of bringing in new and dangerous plant diseases. Two illustrations of this danger only will be mentioned, but there are many others equally important. First may be noted a new disease of the potato, known as the "potato wart," which there is grave risk of establishing in this country. This disease, once in the soil, destroys the potato tuber, and prevents the culture of this staple. The disease was discovered in Hungary in 1886, and has since spread over portions of Europe and into England, where it is causing great alarm. It has also established itself in Newfoundland, and it is especially from this source that the danger to the United States comes. There is no known remedy for the disease, and its existence in the soil practically puts an end to potato culture. Its introduction into the United States would result in the loss of millions of dollars annually.

The other disease is the "white pine blister rust," which has caused enormous losses in Europe, particularly to nursery stock. This disease has, during the last year or two, been imported on nursery stock into a good many of our states and into the Province of Ontario, Canada. The greatest effort has been made to stamp it out at these points of introduction, and it is hoped that this work has been successful. If this disease becomes established in this country it will result in enormous losses in our pine forests.

Both of these diseases are examples of dangers which can be prevented only by an absolute quarantining of the infested foreign districts so far as importations therefrom to this country of these particular products are concerned. In other words, these diseases are often not discoverable by inspection, and can not be destroyed by fumigation. The pine disease may be present in the pine for two or three years before giving any visible demonstration. The potato-tuber disease may be in imported tubers and similarly escape detection.

HISTORY OF EFFORTS TO SECURE NATIONAL LEGISLATION

The need of legislation to protect this country from the ingress of foreign insect pests and plant diseases has long been felt, but nothing practical has been accomplished except the local quarantine established by the State of California.

[1]For a discussion of some of the more important of these, see article entitled "Danger of Importing Insect Pests," by L. O. Howard, in Yearbook of the Department of Agriculture for 1897.

The first general attempt to secure national legislation resulted from the introduction of the San José scale into the eastern United States and its general distribution on nursery stock.

A convention was held in Washington in 1897, composed of accredited delegates of horticultural societies, nurserymen's associations, state agricultural boards, grange alliances, agricultural colleges, and experiment stations, a large and representative body of men. After full discussion, a bill was drafted, which included both the inspection of foreign nursery stock and of home-grown stock subject to interstate shipment. While this measure received the endorsement of the convention and was submitted to Congress, it was not heartily pushed, and the different interests back of it were not fully agreed as to the desirability of all the features of the measure, and it was ultimately dropped, with the idea of replacing it by a more suitable bill.

No agreement was immediately reached, but in December, 1899, a bill[1] was introduced in the House by Mr. Wadsworth, of New York, very similar in purport to the draft of 1897. This bill was later (February, 1900) reported favorably from the Committee on Agriculture by Mr. Haugen, of Iowa, with the unanimous recommendation of the committee that it pass. In reporting this bill, Mr. Haugen gave a very clear statement of the conditions in the matter of imported nursery stock and also home-grown stock, and the arguments for the act, and stated in conclusion that "in the opinion of the committee this bill is a step in the right direction and worthy of early and favorable consideration."

Objections were made to this measure again, both by the nurserymen, who feared that it might put obstacles in the way of their foreign import business, and also on the part of certain state officials, who were fearful that the portion relating to inspection of home-grown stock would prove a duplication and unnecessary, and this measure also failed of passage.

The year following this same bill was introduced in the Senate without change, except date, by Senator Perkins, of California (S. 5615, 56th Cong., 2d sess., Jan. 17, 1901), but its passage was not pushed.

During the succeeding years, either by correspondence or by conferences, an effort was made, particularly by the state entomologists and state horticultural inspectors on the one side and the American Association of Nurserymen on the other, to draft a bill for recommendation to Congress which would be mutually satisfactory. Finally, in 1906, a joint legislative committee was arranged for, representing the Association of Official Horticultural Inspectors, the American Asso-

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[1]Fifty-sixth Congress, first session, H. R. 96, December 4, 1899.

ciation of Nurserymen, and the Association of Economic Entomologists. This joint committee adopted a series of resolutions the following year, calling for national legislation very similar to that recommended by the original convention of 1897, namely, providing for inspection and regulation of foreign importations, and also the national supervision and inspection of home-grown nursery stock entering interstate commerce, and further providing for the extermination or control of imported insects or plant diseases which have only become locally established in the United States. While this program of legislation was adopted by the joint committee and was afterwards approved by the Association of Official Horticultural Inspectors, it was rejected by the Association of Nurserymen at their meeting of 1908, very largely on the ground of their objection to national legislation covering home-grown stock. The Nurserymen's Association, however, indorsed the movement for proper national legislation to prevent the importation of new insect pests on foreign-grown nursery stock. In the same year (February 3, 1908) the Wadsworth Bill of 1899 was again introduced in the Senate, this time by Mr. Flint (S. 4857), and was referred to the Committee on Finance, where it died.

It will be seen from this résumé of the efforts to secure national legislation up to the end of 1908 that the chief objects aimed at had been two, namely, (1) to provide for the inspection and control of imported nursery stock, and (2) to have national supervision and inspection of home-grown stock wherever such was to become subject to interstate shipment, and the objection on the part of the nurserymen and others had always been aimed chiefly at the second of these objects. There had been at no time any serious objection to the general proposition of protecting this country from foreign insect pests which might be accidentally introduced on nursery stock.

Following the action of the Association of Nurserymen in 1908, in refusing to entertain any further consideration of a national inspection law, the subject of a national bill was dropped by all the interests heretofore concerned in such a measure.

THE IMMEDIATE DANGER LEADING TO THE PRESENT EFFORT TO SECURE LEGISLATION

The recent effort to obtain a national quarantine law resulted from the discovery, early in 1909, that brown-tail moth nests, filled with hundreds of small hibernating larvæ, were being introduced into this country in great numbers and distributed to many states on imported European nursery stock, chiefly from northern France.

This state of affairs was repeated during the importing season of 1910. Time will not be taken to give the details of the shipments and

distribution of infested nursery stock during these years. Some idea of the situation can be gained, however, from a brief summary of importations and foreign conditions drawn largely from the annual reports of this bureau, by Dr. Howard, for the years 1909 and 1910.

Brown-tail moth nests imported in 1909.—The first discovery of nests of the brown-tail moths in foreign nursery stock was in a shipment of seedlings from Angers, France, to New York. The discovery was made and reported to this bureau by the commissioner of agriculture of that state. A little later, advices from Ohio indicated that the winter nests of the brown-tail moth had been found upon seedlings imported from the same locality in France. Warning letters were promptly sent out by Dr. Howard to the different state entomologists and a special arrangement was made through the kindness of the secretary of the treasury with the customhouses and by agreement with the railroads, so that the bureau was notified of all cases of plants received at the customs ports or handled by the principal railroad companies. By this means the receipt and ultimate destinations were ascertained of probably all the imported stock. The bureau was thus enabled to notify state inspectors and other competent persons near the points of ultimate destinations of such packages, and inspection was brought about in probably all instances in the cases of plants received after January, and also probably before that time. In all, information was secured concerning nearly 800 shipments divided among 35 different states. In shipments to 15 of these states, namely, Alabama, Georgia, Illinois, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio and Pennsylvania, nests of the brown-tail moth were found, and in one locality in Ohio a single broken egg-mass of the gypsy moth was found. These brown-tail nests, each containing four to five hundred young larvæ, were found by hundreds in these shipments, some 7,000 nests (2,800,000 larvæ) being found in the shipments to New York state alone. Prof. P. J. Parrott, of the New York Agricultural Experiment Station, at Geneva, N. Y., also found in his summer's inspection still another European fruit pest, *Hyponomeuta padella*, which had probably been introduced on these same French seedlings.

Brown-tail moth nests imported in 1910.—In the importing season of 1909 and 1910, in spite of promises on the part of French authorities to see that proper inspection should be made, the shipments of nursery stock from France again brought to this country many brown-tail moth nests. Moreover, one shipment of nursery stock from Belgium to Louisiana contained an egg cluster of the gypsy moth. All of this imported European stock was again followed up, so far as possible, by a continuation of the arrangement referred to of the previous year with

the Treasury Department and customs officers and by agreement with the railroads, and probably most of the shipments of 1910 were inspected at their destinations.

Of the shipments of 1909–10, 291 were found to be infested with nests of the brown-tail moth, and these went to the states of Colorado, Connecticut, Georgia, Illinois, Indiana, Kansas, Louisiana, Michigan, Montana, New Jersey, New York, Ohio and Virginia.

In most of these states the inspection referred to was made by state officials. In other cases, where there was no state service, inspection was carried out either by employees of the bureau or by expert collaborators appointed for the purpose.

Investigation of European nursery conditions.—During the summer of 1909, and also again in 1910, Dr. Howard, who was in Europe principally to supervise the introduction of parasites for the gypsy and brown-tail moths into Massachusetts, made a careful inspection of the nursery regions of Holland, Belgium, and northern France and also England.

The writer was in Europe, on a personal trip, in the summer of 1909, and made an examination of similar conditions in Holland, Belgium, and parts of Germany.

Holland probably presents the cleanest bill of health in the matter of insect pests, and particularly of the gypsy and brown-tail moth. This country enjoys a good inspection service, and all Dutch nurseries are carefully inspected twice each year, so there is probably less danger now from shipments from Holland than any other country.

Belgium in 1909 was in very bad condition, and the writer found the brown-tail moth more abundant there than he had ever seen it, hedgerows often being plastered with the winter nests. The location of many of these being only a few miles from the border of Holland, is within easy flight of the moths to large Dutch nurseries. Belgium has, however, since September, 1909, established an inspection service applying only to nurseries exporting to America and limited to field examination, twice yearly, of growing stock. While a distinct improvement, the inspection as indicated is still inadequate as shown by infested stocks still coming under official certificate.

In France in 1909, Dr. Howard found no governmental inspection system of nurseries. The certificates attached to shipments of nursery stock received in this country from France were signed, as a rule, by men connected with agricultural schools, and probably in the case of most of the certificates the stock had never been seen by the expert. At least the conditions of the stock coming to this country during the last two years made it abundantly plain that these certificates were valueless.

Nursery stock for export was found, in many cases, to be grown in the vicinity of hedges and trees infested with the brown-tail moth and gypsy moth and other injurious insects not yet introduced into the United States, and no special precautions were being taken by nurserymen to prevent the infestation of this stock by injurious pests. The brown-tail moth nests are so characteristic and noticeable that it is only by mere carelessness and inattention on the part of French exporters that they are packed for shipment without removal.

As a result of the agitation of 1909, the French exporters promised to take all possible precautions, and the French ministry of agriculture promised to found a governmental inspection service, but, unfortunately, the Chamber of Deputies failed to pass the inspection law proposed by the ministry of agriculture. As already noted, the condition of the inspected material of 1909–10 was no better than in the previous year.

The director of agriculture of France, however, continued to urge the need of a plant-inspection service for export nursery stock, and early in November of this year (1910) this department was advised, through the Department of State and the ambassador of France to the United States, of the final establishment of such service. Later the details of the law were communicated to Dr. Howard by Dr. Marchal, who is charged with its execution.[1]

Dr. Marchal's high reputation gives a guaranty of thoroughness, and a great improvement may be expected in the future in the condition of the nursery stock coming from France.

In England Dr. Howard found that, as in France, there was no governmental nursery inspection. The nursery conditions there are somewhat better than in France, but the brown-tail moth and other injurious insects which might easily be imported on nursery stock, occur in England. The officials of the government board of agriculture of London, stated that the Government had the establishment of a governmental inspection service under consideration and were willing to establish such a service, but the demand for it must come from British nurserymen. An attempt was therefore made by Dr. Howard to get these interests to ask for such service, and, while no action has yet been taken, it seems probable that the English Government will move in this direction.

Significance of the importations of 1909–10.—It is scarcely necessary to comment on the tremendous danger which the importations of nursery stock of the seasons of 1908–09 and 1909–10 has for this country. The enormous cost of the gypsy and brown-tail moths in

[1] See The New French Plant Inspection Service, by Dr. L. O. Howard, Journ. Econ. Ent. 3: 499.

New England is now well known. Throughout the infested districts of New England orchards have been completely destroyed and forests obliterated, and even where woodlands and parks have been protected at enormous expense, their beauty and value have been vastly lessened.

As elsewhere indicated, the United States Government is now spending $300,000 a year in a mere attempt to check the rapidity of the distribution or dissemination of these pests, and the New England States affected are now spending more than a million dollars a year in efforts at local control. Extermination is entirely out of the question, and all these expenditures must go on indefinitely at a probably increasing rate, unless some check by natural means, such as that by parasites, can be brought about. When it is realized that these two pests have been distributed on imported nursery stock throughout 23 states during the last two years, the danger to the whole country is evident, and this danger applies to every orchard and to every nursery, and to every owner of private grounds, and also to our entire forest domain.

The actual value of the importations of nursery stock which are thus jeopardizing the entire fruit and forest interests of this country is comparatively small, although doubtless important from the standpoint of the nurseryman. It consists, for the most part, of seedling stock,—apple; pear, plum, cherry and ornamentals. The value, as declared for customs, of such importations during each of the years 1907 and 1908, of which we have tabulated records, amount to about $350,000, practically the sum which the United States Government is expending annually in endeavoring to limit the spread of the gypsy and brown-tail moths in Massachusetts, and one-third the sum which the New England States are expending annually in attempting to control these pests.

The stock of the last two years which has been most infested has come from northern France, accumulated from various smaller or larger nurseries, including a French seedling agency managed by an American corporation, composed largely of New York nurserymen. Of the stock imported from these districts, some of it, on the statement of the nurserymen, which is not to be questioned, is much better than similar stock grown in this country. This applies particularly to pears, cherries, plums and quinces. Apple seedlings, up to a few years ago, have been largely of American growth. The establishment of this French-American company and the growth of foreign importations has resulted in a great deal of such stock being now obtained from France. Mr. F. W. Watson, of Topeka, Kan., in an article in the *National Nurseryman* for January, 1910, page 437, on

"American-grown Apple Seedlings," states that from twenty to forty million of American-grown apple seedlings are used in this country every year, the production of about a dozen nursery firms. The bulk of the seed used comes from France, and therefore is of the same stock as the imported French seedlings.

Admitting the necessity for the importation of such foreign stock, it becomes all the more imperative that such stock should be subject to proper inspection and that every possible means should be taken to safeguard this country from the introduction of new plant enemies.

RENEWED EFFORTS TO SECURE NATIONAL LEGISLATION

As soon as this new danger from brown-tail and gypsy moths became known, a national quarantine inspection bill was prepared by the writer, in consultation with Dr. Howard, relating solely to imported nursery stock, with the object of meeting the immediate emergency and protecting the country from these two very serious pests, as well as to furnish future protection from other foreign insect pests and plant diseases. The main objection to the earlier bills was avoided by eliminating altogether the subject of local inspection of nurseries or supervision of widely distributed pests—a field which has been taken up efficiently in many states, and is more or less covered in all. In other words, the measure was drawn to apply solely to imported nursery stock and to new and locally established pests.

This new bill (H. R. 27367) was reported by Mr. Scott from the House Committee on Agriculture in January, 1909, was unanimously recommended by this committee, and passed the House. It was then reported from the Senate Committee on Agriculture and Forestry by Mr. Long, without amendment, and would undoubtedly have become a law in due course if objections to its passage had not been made at this time by the legislative committee of the American Nurserymen's Association. This committee came to Washington and presented to Dr. Howard and the writer their objections to certain features of the measure, and inasmuch as it seemed possible to adjust some of these objections and there was not time to effect this immediately (as any compromise would have to be again referred to the Association of Nurserymen), after consultation with Mr. Scott, the chairman of the House Committee on Agriculture, it was decided to withdraw the bill for that session and endeavor to meet the objections of the nurserymen so far as practicable without materially detracting from the value of the measure.

This bill, in important features, was the same measure now presented to Congress for action. Its chief divergence from the present bill is that it provided for inspection of imported stock at port of entry,

a proceeding which undoubtedly would give this country the greatest possible protection, and is the rule in foreign countries.[1]

The nurserymen, however, held strongly that such examination would probably result in serious injury to or loss of stock, and in view of this and the further consideration that examination at the port of entry would necessitate considerable expense for warehouses, this feature was dropped, and in its place inspection was provided for at point of destination, thus meeting the main objection of the nurserymen. Furthermore, the new bill, to enable the department to have advice in advance of the intended importation and of the date of probable arrival of nursery stock to be inspected, provided for a permit system similar to that now in force in the case of importations of domestic live stock or other animals and birds.

This revision was carried on by correspondence and included several changes wished by the nurserymen in addition to the main point of examination at final destination. Nevertheless, the nurserymen failed to give their full approval to the bill, and at their summer

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[1]The growing fruit interests of Canada are protected from foreign pests, including those now established in this country, by comprehensive quarantine regulations, which are very strictly enforced. As a rule, these require the examination of imported stock at port of entry and before its distribution. An interesting statement, showing the feasibility of such examination at port of entry and the results of this governmental care, is given in a recent report to the Department of Commerce and Labor by Consul General George N. West, of Vancouver. (Daily Consular and Trade Report, August 30, 1910, p. 654.) Speaking of the rigid inspection of nursery stock and the development of the fruit interests of British Columbia, Mr. West, in part, says:

"The growth of the fruit industry in this province may be gauged by returns of imported nursery stock which the provincial inspector of fruit pests has recently transmitted to the government. The number of trees and plants inspected at Vancouver were as follows: During the first four months of 1910, January, 592,002; February, 103,184; March, 767,152; April, 1,255,718; total, 2,718,056. The inspector expects that the number of trees and plants to arrive during the other eight months of 1910 will bring the total up to 4,000,000.

"Every tree and plant is inspected as it passes through the station. This entails a vast amount of labor. Owing to this rigid inspection before the stock is delivered to the buyers for planting in the great Okanogan, Similikameen, East and West Kootenai, and the boundary country, there is not a trace of the San José scale or the brown-tail or gypsy moth. The equal freedom from the codling moth corroborates the statement that the nursery stock received for planting purposes is subject to most rigid inspection, as well as fruit imported from eastern Canada, United States and other countries. The importance of this fact to fruit growers can hardly be overestimated, as it enables them to guarantee the soundness of fruit to purchasers. . . . "The inspection of fruit coming into British Columbia is rigid and effectively enforced without partiality to the section in which it is grown, eastern Canadian fruit being condemned as quickly as American if it is not clean and free from

session of 1909 they suggested a modified bill.[1] This was the Scott Bill, with a good many features eliminated, which are believed to be absolutely essential to the safeguarding of the country. For example, the substitute bill proposed by the American Association of Nurserymen omitted (1) inspection in the country from which the importation is made; (2) the indication of the country or district in which the stock is grown; (3) provision making the fumigation or disinfection at the expense of the owner or consignee; (4) the provision for placing a quarantine, so far as any particular kind of plant is concerned, on any foreign district where such plant is known to be infested with a dangerous insect pest or plant disease not now in this country (section 8 of the bill now before Congress); and (5) other sections weakened by the omission of necessary certificates and of penalty for counterfeiting or wilfully altering the same.

It will be seen from these omissions that the substitute offered by the nurserymen was hardly one to meet the emergency and fully protect the country. The important objection of the nurserymen had been met in the omission of examination at port of entry, and it did not seem wise to yield on these other matters vital, in the judgment of this department, to the protection of the country and, at the same time, not necessarily imposing any hardship or restrictions on the importing nursery business.

In December, 1909, this nurserymen's bill just discussed was submitted to a number of state horticultural inspectors at their annual meeting in Boston, and, at the suggestion of the latter, two provisions were added which had been eliminated by the nurserymen, namely, that providing for a foreign certificate to accompany imported stock (section 2), and also the section empowering the Secretary of Agriculture to extend the provisions of this act to fruits, vegetables, and other plant products not specified in the act, should occasion for such action arise. A minor amendment was also inserted in the first section providing that shipments of less than 1,000 trees or other plants may be inspected at port of entry. The latter provision is an impractical one, inasmuch as it would require just as much machinery to

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all kinds of insects and pests. Therefore, American shippers to the markets of British Columbia should see that their fruit and the packages it is shipped in are clean and free from pests of all kinds, otherwise it will be condemned and losses will occur on such unclean shipments."

This statement shows that the objection to examination at port of entry is largely theoretical, and undoubtedly a larger protection is secured to a country by this method.

[1] Nat. Nurseryman, July, 1909, p. 212.

make examination of the smaller shipments as it would to examine the entire foreign importations, and would entail a needless expense.

The important feature omitted from the original nurserymen's bill was again omitted from this compromise measure, namely, the power given the Secretary of Agriculture to quarantine against the introduction of particular plants from any foreign district where such plants are infested with insects or disease new to this country and particularly such as cannot be kept out by inspection or disinfection. Several of the minor, but nevertheless important, omissions already noted in the case of the first draft of the nurserymen's bill characterized also this substitute measure.

Inasmuch as these omissions were deemed vital defects in the measure by the authorities of the Bureaus of Entomology, Plant Industry, and the Forest Service of this department, a new bill was drawn up, embodying the amendments agreed upon between the nurserymen and this department and retaining the features believed to be necessary to safeguard the country from the introduction of new pests.

Shortly after the opening of the second session of the Sixty-first Congress, Mr. Simmons of New York, at the request of his local constituency—fruit growers and nurserymen—reintroduced the Scott Bill of the previous session (H. R. 15656, December 16, 1909). The new draft referred to in the preceding paragraph, providing for inspection at final destination, and introduction by the permit system, was submitted to Mr. Simmons, who promptly introduced it in substitution for the bill which he had already presented, and it was referred to the Committee on Agriculture and ordered printed. (H. R. 23252, March 21, 1910.)

This bill, as already indicated, had been altered to meet the demands of the nurserymen in every particular which it was felt could be done without materially affecting the usefulness of the measure. Nevertheless, the same nurserymen's committee which appeared the previous year again came to Washington and made active objection to the measure, chiefly on the score of section 8, and, as a result of this objection and the peculiar conditions of that session of Congress, which made it almost impossible to enact new legislation, this bill went over to the next session of Congress. A lengthy hearing, however, was given on this measure before the House Committee on Agriculture, participated in by representatives of the Bureau of Entomology and Plant Industry of the United States Department of Agriculture, a committee from the nurserymen's association, and a number of individuals representing horticultural and nursery interests, also the state entomologists of the states of New Jersey, West Virginia, Virginia and Maryland. All those appearing before the committee were

heartily in favor of the measure as it stood, with the exception of the nurserymen, who objected to section 8.[1]

Before the adjournment of this session of Congress, however, the bill was reintroduced by Mr. Simmons, with a few verbal corrections suggested by the House Committee on Agriculture (H. R. 26897, June 15, 1910), and is on the calendar, and will come up for action this winter.

STATUS OF OBJECTIONS TO THE BILL NOW PENDING

The imperative need of a measure of this kind is universally admitted. All of the great fruit-growing and forestry interests of this country are unanimously and heartily in favor of this bill and have been very anxious for years for legislation of this kind. A great many producing nurserymen also are in favor of the bill just as it stands.

The final objection on the part of the importing nurserymen is to section 8 of the bill, which, as already indicated, provides for the quarantining of foreign districts containing some particular insect or disease infestation on particular plant or plants and new to this country. This section is intended to apply particularly to such insects or diseases as can not be kept out of this country by inspection and disinfection, a condition which merely to state demonstrates the necessity for this section. Inasmuch as the design of the bill as a whole is to allow importations of stock from districts which are infested, for all of central Europe is infested with brown-tail moth and gypsy moth, it is patent that for these and similar pests there would be no object in quarantining any special district; but in the case of insect pests or diseases which have not yet gained a foothold in this country, it is a matter of very great importance, in view of our past experience with such pests, to give them no chance of entrance, and this can be gained only by absolutely prohibiting the importation of stock from districts where these new and dangerous insects are known to exist. Inspection is not infallible, and there is no method of fumigation which can be absolutely relied upon to be always efficient to the degree of 100 per cent. Therefore, to keep such new enemies out of our country, the only method is to prohibit the introduction of stock which is likely to bring them in. As shown later on, however, the necessity for this action will probably rarely occur, and will little affect the general importing business.

That the action of these importing nurserymen does not represent the general nursery business throughout the United States is evidenced

[1]These hearings are published under date of April 27, 1910, and give a very complete presentation of the pros and cons of the proposed bill.

by the testimony of other nurserymen before the House Committee on Agriculture and letters on file in this bureau. Furthermore, the thousands of nurserymen throughout the country have interests exactly identical with those of the fruit growers, and are just as much interested in having protection as are the former.[1]

The need of such quarantine under this section will rarely be called for on account of injurious insects, most of which can be detected by inspection or destroyed by fumigation. There may, however, arise insect dangers which will require the enforcement of this section, and it is very desirable to have the provision in the measure to meet such emergencies, as, for example, insects or their eggs or other stages within plants or seeds which can not be seen and are beyond the reach of fumigants.

In the case of plant diseases, however, this section is of vital importance, and the experts of the Bureau of Plant Industry of this department and plant pathologists generally unite in indorsing it. Professor Galloway, chief of the Bureau of Plant Industry, in a letter to Chairman Scott, of the House Committee on Agriculture, dated April 29, 1910, says:

"Section 8 is the most important part of this bill, so far as the control of fungous diseases is concerned; and I judge is much more important in this relation than in relation to insect pests. For the present, the legislation called for in this section would be directed only against the diseases known as 'potato wart' and 'white pine blister rust.' So far, potato wart is on this continent only in Newfoundland, and we want to quarantine against Newfoundland, in order particularly to protect the potato-growing sections of New England. Inspection for this disease is not practical, on account of the large quantities of potatoes which may be imported, making it physically impossible to examine each potato; and for the further reason that the early stages of the disease are difficult to detect by inspection.

"Ninety-five per cent. of all the blister rust of white pine now in this country has come from one town in Germany; we want to be able to quarantine against this town and other places where we know positively that the disease is or has recently been present. Inspection is here, again, not practicable, because the disease incubates inside the plant, and can seldom be detected until it breaks out on the surface

[1] The *National Nurseryman* of May, 1910, p. 581, in an article on the inspection bill urges, editorially, even a broader application of the principle involved in section 8, namely, that "the United States Entomologist . . . should have such authority as will permit him to exclude importations from nurseries or regions known to be infested with injurious insect pests or from nurseries flagrantly careless with reference to these enemies."

of the plant, several months, or years, after it has been received in this country.

"So if this bill were passed without section 8, it would, from the standpoint of this bureau, be of very little service against these diseases."

The objection of the nurserymen, therefore, to this section seems to be unwarranted, and the more so as the other provisions of the bill would empower the national authorities to destroy such infected stock promptly on its arrival at destination, so that the nurserymen would simply have the added expense of the original cost of the stock and of transportation. It is difficult to believe that a proper appreciation of the conditions will not lead importing nurserymen to abandon their objection to this section.

A misconception seems to have arisen in the minds of several of these importers in regard to this section, namely, the belief on their part that the power of quarantine granted by this legislation will check all importations from quarantined districts. As a matter of fact, the quarantine will apply merely to the particular plant or vegetable product which carries the danger; in other words, a quarantine against the white-pine disease would have no bearing whatever on the importation of fruit seedlings or ornamentals other than pine.

With relation to the attitude of the importing nurserymen and of the National Nurserymen's Association, it should be said that in their conferences with entomologists, fruit growers, etc., and before the House Committee on Agriculture in Washington, these interests have always expressed their desire to promote legislation to protect this country from new insect pests or plant diseases which might be accidentally introduced on nursery stock, and the objections voiced by them have been to the details of the various measures presented to Congress rather than to the general principle.[1]

In conclusion, it may be added that the same permit, inspection and quarantine system has long been the law in the case of imported live stock, representing much greater values, and has worked to the entire satisfaction of importers.

NATIONAL VERSUS STATE CONTROL

The question has arisen, and properly so, in the discussion of the need of a national inspection and quarantine law relating to plants

[1] The real attitude of importing nurserymen has been uniformly to oppose and hinder any remedial legislation, as shown in the reports of the committee to their own association and published in *The National Nurseryman.* These reports indicate very plainly that this small body of importers, represented largely by the committee referred to, is opposed, first, to any legislation whatever, and, second, if there must be legislation, to any which in their judgment at all hampers their business.

and plant products imported from foreign countries, whether such inspection and quarantine is not properly the duty of the states and need not, therefore, be undertaken by the National Government. In considering this question, the absolute essential to protection must not be lost sight of, namely, uniform and competent inspection of all imported stock in whatever state or territory it reaches its final lodgment. If it could be predicated that each state would establish and maintain a competent inspection of such stock and could always be advised of its arrival, the object aimed at, namely, protection for the whole country, might be secured without a national law. In point of fact, the interests of the states are so dissimilar that it has been impossible in the past to get the same efficiency in the case of the inspection of local nursery products, and the same condition will apply to imported stock. A few states with large fruit interests have competent officials, and inspection and quarantine are reasonably efficient. In other states, including many where the fruit interests are very considerable, the present inspection is gravely wanting in efficiency.

A careful examination of this subject was made last summer, and the officials of 37 states reported on the status of existing inspection machinery. Of these 37 states, 14 reported the service as not good, 7 as doubtful, 12 as generally good, and 4 as unqualifiedly good. It is worthy of note, however, that of the four reporting as unqualifiedly good, only one has an adequate system of inspection and control, the others being among the least protected.

Left to the states, the examination and control of imported stock would fall into about the same condition as the existing inspection and control of locally grown stock, as shown by the above statement. Any laxity or carelessness in one state would in the end vitiate all the good work of the others.

Furthermore, a good many provisions of such law would have foreign relations, namely, the requirement for a certificate to accompany the stock, and quarantining of foreign districts when such action becomes necessary, and these matters could not be properly undertaken by the several states. With national control, the whole work could be coördinated and made uniform and the largest amount of protection would undoubtedly be gained. The existing state machinery and officials would necessarily be employed in this work where available. The cost of such inspection will probably not be large, and on the present basis of importations of stock of the customs value of about $350,000 annually, it is believed that this inspection and protection can be secured at a probable annual cost of $25,000.

Dr. Howard: It would be well to state here, while I think of it, that a species of Aleurodid, new in the United States, was imported this year from Holland.

Dr. Smith: I am afraid in our inspection work that the tendency is to confine inspection to certain lines of insects. It may be interesting to know that a shipment of hemlock from Japan was badly infested by a Tineid moth, not only new to this country, but to science. Some of the British nurserymen, particularly in Ireland, have found it desirable to have their nurseries inspected by European entomologists, and they present certificates which, while they have no official significance, show their desire for clean stock. Some of these certificates are signed by Professor Carpenter at Dublin, and some by Professor Theobald and other entomologists, and those certificates, while having no official standing, at least represent the work of conscientious men, and men of standing, and they deserve recognition, so far as certificates are recognized, until the nurserymen there are elevated to the knowledge that it is important to have clean stock.

Dr. Howard: There was a case which came to my attention of the White Pine Blister Rust being sent from a nursery from the State of New Jersey, which the nurseryman admitted to me himself had come in a shipment from Germany.

President Washburn: Dr. Howard, in the matter of imported bulbs, what mite or mites would be apt to be found upon them?

Dr. Howard: There is a bulb mite, at least one, which is very important. We ought to keep it out. Every bulb ought to be inspected. That question has been asked by many state entomologists and I have always replied that I think we ought to inspect bulbs.

President Washburn: Is there any chance of securing any federal funds for furthering this work in the several states?

Dr. Howard: The bill carries an appropritation of $25,000 only.

Dr. Smith: Before the discussion closes I should like to offer this resolution: Resolved, That this Association heartily indorses the Simmons Bill in all its parts. I offer this resolution for the committee of which I am chairman. Motion seconded and carried.

Mr. Atwood: There is hardly a block of trees in the State of New York but that some one of our inspectors knew the history of it before it was planted. We keep pretty close watch, and if a man is going to plant a new section, the surroundings are all carefully examined to see if the thing is all right. The old orchardtrees or hedges are avoided by the nurserymen. The examination of the orchard is practically an each-tree examination in an area where we know the San José scale is likely to be. The examination of a nursery would be, in case of San José scale, taken up row by row, or tree by tree if a small

nursery. You see we are not limited for time. You speak of some of the difficulties you have—does this not come from the fact that you make the nurserymen pay for their inspection?

PRESIDENT WASHBURN: They pay very little,—from $1.50 to $6. Average about $4.50.

MR. ATWOOD: I think if we insisted upon the nurserymen in New York paying for their inspection, they would not send for the inspector so often. They are afraid of the laws of other states, and do not want to ship stock and have it rejected by other states. They want to hold their trade from year to year, and they not only ask inspection of nurseries, but they ask special examination. They want the stuff to go through without any question of its being right. This leads to special fumigation. I think that entire nursery blocks in the state of New York practically have every tree inspected. Where there is no infestation the first examination would call for every third row, or skipping two rows and taking two rows, but it is in large blocks where the trouble comes. I think they will have to go deeper into it, and look out for the old plum trees and old hedgerows. Where do we get the infestation? It comes up almost out of the ground. You cannot tell where it comes from—you simply know it is there. In one instance we had a little block of 10,000 pear trees two years old destroyed because of the presence of scale. We had examined this block a great many times, and never saw any infestation, but I was going out one day and saw a scale. We spent a great deal of time the rest of that summer and found another scale or two. All of us were in there many, many hours at different times, and no scales developed there that summer, but the next year I suppose 200 trees were destroyed in that bunch. It is quite often necessary with peach stock, to get down on hands and knees and search until the trouble is found. As I remarked this morning, it was not the intention to give any nurseryman a certificate as long as there was any live scale on his stock. Since the discovery of the usefulness of lime-sulphur for the control of San José scale in orchards, very few orchards have been condemned. I think the time is coming when nurserymen will demand that their stock be treated for scale.

PRESIDENT WASHBURN: The next paper on the program is on the bulb mite. It will be read by Mr. Engle.

THE BULB MITE

(*Rhizoglyphus hyacinthi* Boisd., Syn. *Rhizoglyphus echinopus* Michael)
Also known as the "Eucharis Mite"

By FRANCIS WINDLE, *Westchester, Pa.*

Although this bulb pest seems to be world wide in its distribution, and very serious in the extent of injuries to such plants, but very little attention has been given to it by American economic zoölogists, and the importers who were accustomed to seeing and throwing out large numbers of injured and diseased bulbs annually were apparently not aware of its existence, until a system of inspection in Pennsylvania, by the economic zoölogist, Prof. H. A. Surface, brought it to their attention the present year.

It is further quite evident that European growers of bulbs, if acquainted with it, have not realized its damaging nature, and have done little, if anything, to check or control it.

The first inspection was made on August 4th, and the latest on December 1st, 1910, at Philadelphia; both importations being from Japan and containing mites. During the four months intervening, samples of thousands of cases were inspected. Decayed bulbs, upon microscopic examination, showed fungus and bacteria, and some eel-worms (Nematodes). At the same time virtually all decayed bulbs, whether from soft or affected by dry rot, contained mites.

The question naturally arose what injury the mites were responsible for? Whether they simply followed decay from fungus or other cause, or whether they did direct injury. Investigations were therefore continued with this point in view. These mites were soon found in solid bulbs, and a wide scope of direct injury was discovered, from slight stains, through grating wounds from eating the scales either base or tops, to complete riddling of the entire bulb.

The bulk of the importations examined came from France, Holland and Japan, to importers in Philadelphia and vicinity. They consisted of hyacinths, narcissus, lilies and callas of numerous varieties. Some of all these bulbs, from whatever country received, were infested with the "Bulb Mite." They were also found in peony roots.

The direct injury of these mites was strikingly shown in a late importation of *Lilium brownii* from Japan by a Philadelphia seed house. In assorting them a large number had been thrown out, showing no other injury than that caused by the mites, the bases of the scales being so eaten that they would drop off from handling and the "cushion" or root crown alive with them.

There are no doubt some bulb diseases that the mites are in no way responsible for, but from my observations in these inspections, I would conclude that the mites were, in addition to their own direct injury, responsible for injurious diseases; and that fungi and bacteria were often "secondary intruders."

This conclusion is supported by George Massee of England in a recent publication. He says of the Bulb Mite—"There was at one time some difference of opinion as to whether the mite was the primary cause of injury to bulbs infested with it. It was thought that the injury might be due in the first instance to some error of treatment, and that the mites were simply feeding on the more or less decayed portions. It has, however, been definitely proved by Michael that the mites are the primary cause of injury, and that indeed they prefer sound bulbs. . . . The mites are very minute. They are yellowish-white in color with just a suffusion of pink, the legs and rostrum are red."

Erwin F. Smith, pathologist of the Bureau of Plant Industry, Washington, D. C., reporting on specimens of bulbs sent him, says, after noting the presence of fungus and bacteria,—"All the bulbs, however, are badly infested with mites, . . . which very probably are responsible for the trouble, not only by direct injury, but by affording an entrance for fungi and bacteria."

Dr. Howard in his report on the same specimens says, "These mites *burrow into living healthy bulbs*, and thus give entrance to destructive diseases. They are very difficult to control, and your best plan will be to destroy the entire lot. Those which you sent are very badly infested. Importers should require mite-freedom certificates from European growers."

If we should act upon Dr. Howard's advice it would put an end to the bulb trade.

Some help might come from treating the bulbs, as by fumigation, and the growers might treat the soil, but the pest is everywhere, even in our home-grown onions,—possibly potatoes and other roots and tubers.

Mr. Engle: I have examined a great number of foreign bulbs, and never found one consignment in which there were not mites. I would like to know what action is going to be taken regarding this bulb question. If, as suggested by Dr. Howard, these bulbs are destroyed, it will put an end to foreign importation.

Professor Summers: Is it not fair to assume that this mite would prove injurious in this country, and that any action we might take now in destroying the bulbs would be simply useless? Will it not establish itself in this country anyway?

PRESIDENT WASHBURN: Have we not numbers of mites in this country which are doing the same injury?

MR. ENGLE: Doubtless we have.

PRESIDENT WASHBURN: It seems to me that bringing in imported bulbs is not making the condition worse.

MR. BURGESS: I think that the value of bulbs imported is greater than that of nursery stock, if I remember correctly the statistics on the subject.

MR. ENGLE: That is very true. I know of instances where some large importers have imported as many as 500 or 600 cases of bulbs in one importation. I am very sorry Dr. Howard is not here to let us have his views on the matter. I should like to know just what position he would take.

MR. ATWOOD: We have had a large number of shipments of bulbs this fall, and have not given it very much attention.

PRESIDENT WASHBURN: You are not inspecting bulbs now?.

MR. ATWOOD: Not what we call inspection.

MR. ENGLE: I would say that we do not intend to inspect all bulbs. I asked the Secretary of Agriculture for his opinion, and he said simply keep track of the importations, occasionally examining bulbs, letting the importers know that we kept tab on them at least. It would take probably three or four months in the fall to inspect all the bulbs that come in, and probably fifty men.

(To be continued)

SYMPOSIUM ON TEACHING. The series of papers on teaching entomology contain much that is most suggestive. The discussion reflects the enormous strides made in the last generation and presages equally great advances in the next, if specialization in teaching and investigation is any criterion. We fully endorse the emphasis placed by some upon the need of a thorough general course, giving due attention to the well-recognized cultural studies as well as those more intimately related to entomological work. The foundation must be satisfactory or the integrity of the superstructure may be threatened. Let us, while urging the need of adequate courses in entomology, remember that correlated subjects should not be neglected. The teacher has an important responsibility in this respect.

The availability of insects for work in zoölogy and biology should be more generally recognized. Such instruction serves to call attention to a group altogether too frequently overlooked by the general public. Important changes in this respect have followed recent discoveries, though still further revision is necessary on the part of many before they obtain the correct perspective.

A NOTE ON THE INDIAN ENEMIES OF ALEYRODES CITRI R. & H., WITH DESCRIPTION OF A NEW SPECIES OF PROSPALTELLA

By L. O. Howard

In the course of the investigations carried on by the Bureau of Entomology of the United States Department of Agriculture of the white fly of the citrus orchards of Florida (*Aleyrodes citri* R. & H.), much attention has been paid to the question of natural enemies. This species, however, seems to be singularly free from the attacks of predatory insects, and no insect parasite in America has been discovered. There are a number of native species of Aleyrodes, and the climate and flora of California seem to be particularly suitable to the insects of this genus. Moreover, in California they are abundantly parasitized by various species of Aphelininæ and certain Proctotrypids.

In the course of the work in Florida, not only has no parasite been bred from *Aleyrodes citri*, but in spite of numerous attempts to introduce parasites of other species of Aleyrodes sent in from various parts of the United States, the agents of the bureau have not been able to induce them to oviposit in *A. citri*. The peculiar flattened form of this species and the small amount of sustenance which even a nymph would afford an internal parasite, together perhaps with some other unknown quality, seem to render it unfit for the food of native parasites.

As a result of these conditions it was deemed doubtful by the writer, and by Mr. Quaintance whose work upon the Aleyrodidæ has made him particularly conversant with this group, whether any true internal hymenopterous parasites of this species exist. Nevertheless, failing mechanical measures of control sufficiently economical in operation to appeal to the practical orange growers of Florida in the way that such measures appeal to the deciduous fruit growers of the more northern states, it was deemed advisable to make a thorough search for the original home of the white fly and for possible parasites and predatory enemies which might exist there if the locality should be found.

In consequence Congress was asked for an appropriation for this purpose, and Mr. R. S. Woglum of the Bureau of Entomology started in July, 1910, on an extended trip. His itinerary need not be described here, but it is interesting to announce that he has found *Aleyrodes citri* occurring upon citrus plants practically wherever these grow in

India. Even in localities where citrus trees grow in the jungle, apparently wild and mingled with jungle vegetation, *Aleyrodes citri* was found. Everywhere in India, however, he found that the species was under control although no artificial measures are used. Nowhere did he find trees blackened with the concomitant smut fungus, a sight which is all too common in the portions of Florida where the white fly exists. In only one instance, in the center of a thickly growing tree, did the presence of black smut indicate the presence of the white fly in at all unusual numbers.

These conditions indicated the presence either of internal insect parasites—presumably hymenopterous,—efficient predatory insect enemies or efficient fungous diseases, or all three. At Saharampur in the valley of the Ganges, not far from Delhi, he found a fungous disease which he sent to Prof. H. S. Fawcett, of the Agricultural Experiment Station at Gainesville, Fla., who has found that it is identical with the species already occurring in Florida, namely *Aegerita webberii* Fawcett. He also found in this same locality, in the Botanical Gardens, two species of Coccinellidæ which he has sent over in small numbers, but which have not as yet been received in living condition.

These Coccinellidæ have been determined by Mr. E. A. Schwarz of the Bureau of Entomology. The first one is *Verania cardoni* Weise The specific determination is certain, but there may be some doubt as to the generic position. The species belongs to the Coccinellidæ which are supposed to be aphidivorous. It seems not to be rare in India, since its name appears upon the various lists of Coccinellidæ collected in that country. The second species is supposed to be *Cryptognatha flavescens* Mots., described from Ceylon. The description is a little more than one line in length, and the determination is therefore doubtful. No species of Cryptognatha or allied genera appears upon any list of the Indian Coccinellidæ which Mr. Schwarz was able to consult. The only North American species of Cryptognatha (now separated by Casey as a different genus), *C.* (*Oeneis*) *pusilla*, is known to Mr. Schwarz to feed upon Lecanium and Aleyrodes.

At Lahore, Mr. Woglum found his first evidence of internal parasitism by hymenopterous parasites. A certain proportion of the Aleyrodes found upon orange (Mr. Quaintance has confirmed the identity of the species with *A. citri*) were found containing the exit holes of a true parasite. The specimens on leaves sent in by Mr. Woglum have been examined with great care. None of the full-grown larvæ or nymphs contained pupal parasites, but five specimens of a very minute Aphelinine of the genus Prospaltella were found dead and attached to the orange leaves in the close vicinity of the perforated Aleyrodes. The size of these specimens is such as to justify

the conclusion that they had issued from Aleyrodids, and their juxtaposition and the known habits of the genus confirm this conclusion.

The genus Prospaltella is as a rule parasitic upon Diaspine scale insects, but certain species have been bred from Aleyrodids as follows: *P. tristis* Zehnt. was reared from *Aleyrodes bergi* Sign.; *P. conjugata* Masi was reared from *Aleyrodes brassicæ* Walk.; *P. quercicola* How. was reared from *Aleyrodes gelatinosus* Ckll.; *P. citrella* How. was reared from *Aleyrodes coronatus* Quaintance, and *P. brunnea* was reared from *Aleyrodes* sp. (on climbing vine). See "A Key to the Species of Prospaltella, with Table of Hosts," etc., by L. O. Howard, Annals Entomological Society of America, Vol. I, 1908, pp. 281–284.

With the reasonable certainty that this insect is a true parasite of the Florida white fly, it becomes important to give it a name, and the following description is therefore presented.

Subfamily Aphelininæ Howard

Genus Prospaltella Ashmead, 1904.

Prospalta Howard, 1894 (preoccupied).

Prospaltella lahorensis, n. sp. *Female.*—Length, 0.54 mm.; expanse, 1.42 mm.; greatest width of forewing, 0.25 mm. Antennæ long, not clavate; scape long, slender; pedicel nearly as broad as long; first funicle joint somewhat longer than second; second and third subequal; club equal in length to second and third funicle joints together; terminal segment of club slightly longer than middle segment, basal segment again slightly shorter. Fore wings broad, with moderately long bordering cilia; disc uniformly covered with minute cilia; stigmal vein rounded below, its anterior margin for a time parallel with costa; marginal vein faintly indicated, its base joining stigmal in an acute angle. (In this respect this species differs from all other known species of its genus.) General color light yellow; all legs pallid; eyes, dark; ocelli, coral-red; antennal club dusky; wings hyaline, wing veins dusky.

Male.—Of practically the same size and structure as the female, but differing in color. The coloration closely resembles that of *Aspidiotiphagus citrinus*, to which it bears a superficial resemblance; pronotum, brownish; mesonotum, orange-yellow; metanotum and epimerum, brownish; abdomen dark brown except at base and tip where it is lighter; hind femora dusky at tips; wing veins distinctly fuscous, considerably darker than in female.

Described from two females and three males found at Washington on citrus leaves, close to specimens of *Aleyrodes citri* R. & H. containing exit holes of some parasite of this approximate size. Collected at Lahore, India, by R. S. Woglum, November, 1910.

Type No. 12169, U. S. N. M.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

The Minnesota meeting was a most successful one, and, like others in recent years, characterized by a crowded program. It is physically impossible to listen to all that might be said, even if the latter were limited to the investigations of any one year. The law of supply and demand applies here as elsewhere. Papers discussing some new principle of wide general interest, or placing on record the results of protracted investigations, are always listened to with great interest and no one begrudges spending the time necessary to a clear understanding of the problem. Another class of papers of general interest are those dealing with methods, illustrated at the recent meeting by the symposiums on teaching and spraying, both matters of vital importance and each capable of being discussed in a brief though comprehensive manner. Another very desirable class of papers adds to our knowledge of the biology, local or otherwise, of various insects, preferably injurious forms. The essentials in these latter can usually be condensed into papers of moderate length, the details being published in the JOURNAL or other serials. We agree most heartily with the secretary in holding that our gatherings should be democratic, every man enjoying equal privileges. The period which can be devoted to scientific meetings is necessarily limited, and with such a large proportion of our membership actively interested in the work of allied societies, it is almost impractical to think of extending our sessions to three days. Fortunately, the standing of an entomologist is not proportional to the time he occupies on the program, or the promise of a younger man indicated by the length of the paper he submits for consideration. Regrettable though it may be, all should recognize our time limitations, and, so far as possible, prepare papers which will give, within small compass, a comprehensive discussion of the problem. The general adoption of this plan, supplemented by our present improved facilities for publishing the details, should go far toward relieving the crowded condition of the program and allow opportunity

for thorough discussion. A congested program in Minnesota means an almost intolerable condition in this respect at Washington unless some such plan is adopted.

Adequate protection from the introduction of injurious insects is most important in these days of unexcelled transportation facilities. The danger increases very rapidly with the perfection of the latter. There are already striking cases, discussed elsewhere in this issue, where even a moderately efficient national inspection service would have resulted in enormous savings, not only in the past but also in the future, on account of pests already established in this country. Economic entomologists have taken no uncertain position upon this question, and, as officials charged with the control of injurious insects, are obligated to do all within their power to establish an efficient though not unduly onerous national quarantine service. This is most emphatically the case where the general welfare of the people as a whole should receive consideration, rather than the interests of a few. We, as a people, have already taken too large chances in this direction. It should be remembered that the gypsy and the brown-tail moth problem in Massachusetts is only the normal outcome of the sowing some twenty or thirty years ago. Such being the case, what will be the result a generation hence, unless adequate steps are taken to check this dissemination of injurious insects and dangerous plant diseases?

Reviews

Farm Friends and Farm Foes, a text book of agricultural science, by Clarence M. Weed (Heath & Co.) 1910, 8 vo., pages 1–334.

This little work gives in simple language and pleasing style, much information, practical and biological, concerning weeds, insects, fungi, birds and mammals. It is written by one with a large personal acquaintance with the various phases of the subject, as well as an intimate knowledge of the literature. The writer has maintained an impartial attitude and endeavored to correctly place the various organisms in relation to their environment, discussing both the injuries and benefits resulting from their activities. Written by an ardent student of natural history, well known on account of his work with insects, this volume contains much of interest to entomologists, and will appeal to a wide constituency because of the large amount of practical and reliable information.

A Neglected Field in Photo-Micrography, by S. B. Doten. Nevada Agricultural Experiment Station Bul. 73, 1910, pages 1–15.

This is unusual among agricultural experiment station bulletins, though very suggestive, particularly as the writer adapts a field camera to the work, and by the employment of special lenses secures most admirable results. The late Professor Slingerland was an ardent and most successful photographer of insects and others

are continuing in his steps. There have been several good papers on insect photography in recent years, and we hope to see this method of illustrating natural objects greatly extended in the near future. We should learn to use the camera rather than the printed page. This bulletin is evidently intended as a somewhat technical one, it hardly appealing to the average farmer. Nevertheless, such bulletins find a place in demonstrating new methods and indirectly may be of great service to the agriculturist.

Current Notes

Mr. A. G. Ruggles, instructor in entomology at Minnesota University, has recently been promoted to the grade of Assistant Professor.

Prof. E. F. Hitchings, State Entomologist of Maine, has been reappointed by the new administration under Governor Plaisted.

Mr. Z. P. Metcalf, Assistant Entomologist of the North Carolina Department of Agriculture, recently spent three weeks at the Ohio State University doing some research work on Homoptera.

Mr. J. B. Parker, Assistant in Entomology at the Kansas Station, has resigned to accept the chair of biology in the Catholic University at Washington, D. C.

Prof. F. L. Washburn, State Entomologist of Minnesota, gave the annual public address before the Minneapolis meeting of the Entomological Society of America on the evening of December 28.

Mr. R. W. Braucher of the Bureau of Entomology has resigned to accept a fellowship in the entomological department of Cornell University.

Mr. Francis B. Milliken has recently been appointed Assistant Entomologist at the Kansas Agricultural Experiment Station in place of Harry Evans, who resigned a short time ago.

Mr. V. I. Safro, of the Bureau of Entomology, has recently been appointed Assistant in Entomology at the Oregon College and Station.

According to *Entomological News*, Mr. J. Chester Bradley is Special Assistant Entomologist of the Georgia State Board of Entomology, Atlanta, Ga., and has undertaken a preliminary catalogue of the insects of that state.

Dr. Henry Skinner, who for twenty-one years was editor of *Entomological News*, has resigned, and the associate editor, Dr. Philip P. Calvert, has been chosen as his successor. The new associate editor is E. T. Cresson, Jr.

Mr. Henry L. Viereck, of the Bureau of Entomology, a specialist on the parasitic Hymenoptera, with headquarters at the new National Museum at Washington, has been at the Gypsy Moth Parasite Laboratory, Melrose Highlands, Mass., for several weeks, studying some of the Ichneumon parasites of the gypsy and brown-tail moths.

We regret to learn, through a recent communication from his son, that Edwyn Carlos Reed, director of the Museo de Concepcion and foreign member of our association, died November 5, in Chile.

Dr. Guy C. Crampton (Princeton, 1904), Professor of Zoölogy at Clemson College, South Carolina, has been appointed associate professor of entomology at the Massachusetts Agricultural College. He spent two years in graduate study at Cornell University (M. A.) followed by two years at the Universities of Freiburg, Munich and Berlin, where he received his Ph. D. in 1908. Dr. Crampton has studied under Professors Comstock, Riley, Slingerland and MacGillivray in entomology in this country, and with Professors Heymous, Kolbe and Degener, abroad. His work at the college, which will begin some time in April, will be mainly in insect morphology.

Mr. W. F. Fiske, of the Bureau of Entomology, and located at the Gypsy Moth Parasite Laboratory, Melrose Highlands, Mass., sailed January 5th for Europe. He expects to be absent until next fall, and will make parasite investigations in Italy, France, Russia and Japan before returning to the United States.

It has been stated in *Entomological News* that Messrs. E. A. Schwarz and A. Busck of the Bureau of Entomology were to leave for Panama some time in January to make a study of the entomological fauna of the Canal Zone, and to search for parasites of the citrus white fly *Aleyrodes citri* and the cotton boll weevil and allied species.

According to *Science*, there has been a movement on foot in the Liverpool School of Tropical Medicine to commemorate the work of Dr. J. E. Dutton, who lost his life in the Congo by contracting spirillum fever in 1905. The movement has been successful, and the School has given to Liverpool University the sum of £10,000, which has been accepted for the establishment of a chair in Tropical Entomology.

Mr. U. C. Loftin, B. S., a graduate of the class of 1910 of the North Carolina Agricultural and Mechanical College, has been appointed Laboratory Assistant in Entomology at the Florida Agricultural Experiment Station, Gainesville, Fla., and entered upon his duties December 1st, 1910. All departments of the Station, including that of entomology, are now housed in the commodious new building.

Prof. H. T. Fernald of the Massachusetts Agricultural College addressed the first annual meeting of the Massachusetts Nurserymen's Association at Horticultural Hall, Boston, December 7, on the "Problem and Progress of Nursery Inspection in Massachusetts."

Prof. F. Picard has been made Professor of Agricultural Zoölogy and Entomology at the Ecole Nationale d'Agriculture at Montpellier, France, in place of the late Prof. Valery Mayet. Professor Picard will be glad to be placed in relation with American economic entomologists and to receive their publications in exchange for his.

Mr. Harper Dean, formerly connected with the Bureau of Entomology and more recently editor of the San Antonio *Semi-Weekly Express*, has accepted the position of Assistant State Entomologist of Texas, and is now located at College Station. Mr. Dean will assist State Entomologist Wilmon Newell in the work of that office, in addition to conducting investigations for the Texas Agricultural Experiment Station.

We are advised that Prof. F. L. Washburn, St. Anthony Park, Minn., desires an assistant in laboratory, class room and insectary; also a field man properly qualified, for experimentation, demonstration to farmers, examining imported and domestic nursery stock. Good salaries to the proper parties.

Mailed February 15, 1911.

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Proceedings of the Twenty-Third Annual Meeting of the American Association of Economic Entomologists

(*Continued from Page 96*).

Morning Session, Thursday, December 29, 1910

PRESIDENT SANDERSON: The first paper will be the "Economic Importance of *Stictocephala*, by Herbert Osborn.

ECONOMIC IMPORTANCE OF STICTOCEPHALA

By HERBERT OSBORN, *Ohio State University*

This genus has not generally been considered of any particular economic importance, but some instances which have come up within the last few months, and evidences secured from various sources, prove that it has an economic importance that cannot longer be overlooked. It may be premised that the species of this genus are many of them widely distributed throughout the country, and in some cases occur in considerable abundance, so that if they increase in number, and at the same time direct their attacks toward any important crop, they may easily become of considerable importance from an economic standpoint.

One of the most widely distributed species is *Stictocephala festina* Say, which has a distribution throughout the entire southern and southwestern part of the United States. This species has been known since its early description by Thomas Say, has been a very common insect

in collections and is likely to appear in almost every collection from its area of distribution. Heretofore, however, there appears to have been no definite record of its attack upon any important crop, and, so far as I know, no suggestion that it may have a distinct economic importance. During the past year it has appeared in my own collections in a number of locations, and especially upon alfalfa and clover, so that it has seemed possible to have a distinct importance. Moreover, during the last few months a number of specimens have been sent to me through the Bureau of Entomology with the information that the insect was injuring alfalfa, so that there seems no longer any question as to its having a definite relation to this crop. The mode of attack of the insect appears to be, in general, the puncturing and sucking of sap from the stems, but in some instances it has been observed that the punctures have been made in a series surrounding some of the stems, and as a result of this attack the plants above the point of puncture wilt and die, so that the injury is very evident.

As the most definite record in hand I may reproduce the following extracts from letters to the Bureau of Entomology from Mr. R. A. Cushman:

TALLULAH, LA., August 27, 1910.

Dr. C. W. Edgerton, plant pathologist of the Louisiana Experiment Station paid us a visit yesterday, during which I spent several hours with him driving over the country and inspecting the alfalfa for diseases. He called my attention to a peculiar girdling of the stems, which he says is caused by a Membracid. I am sending you under separate cover both the adults and nymphs of this species for determination. Doctor Edgerton tells me that he has proved beyond a doubt that this insect is responsible for the injury mentioned by placing alfalfa plants in cages of sterile soil in which some of the insects were confined. The injury appeared over night. His conclusions are further proved by the fact that microscopic examinations of sectioned stems show no disease and that none of the tissue of the plant is removed by the injury but simply shrunken, due to the removal of the plant juices at that point. I have written of this in some detail for the reason that the idea of a sucking insect causing an injury of this character is new to me. I am also sending some stems of alfalfa showing the injury. . . .

September 1, 1910.—Extract from letter of above date: . . . I might add in this connection that it seems to be the immature insects which do the most damage. In regard to the extent of the injury to alfalfa in this neighborhood, so far as my own observations go, I should say that it is rather a serious pest. As we walked through the field the other day the adults would jump up in great abundance and we had no difficulty in finding the nymphs and the injury. The injured stems have a rather characteristic yellowish appearance and these were of rather frequent occurrence, while the newly girdled stems were abundant. However, my observations cover only a short time spent in one field, and I would not, therefore, like to express an opinion as to the seriousness of the pest in this region. The alfalfa industry in the neighborhood of Tallulah embraces but a small acreage on a few plantations, the growing of that crop being still in the experimental stage, but as I find opportunity I will look further into the subject.

The life history of this species has not been followed in detail and as a general thing the form which appears in collections is the adult, and the occurrence of this form is apparently distributed pretty well through the season. However, there is sufficient evidence to indicate that the larvæ develop rather rapidly during the summer, and that they may occur on various plants, perhaps especially upon the legumes, within the range of their distribution.

It would seem from the information so far acquired that this species has under natural conditions, lived upon some of the native leguminous plants, and since the general introduction of alfalfa as a cultivated crop that it has acquired a taste for this food plant. This being the case there is considerable reason to assume that it will multiply and adapt itself still more perfectly to this food plant, so that it may become a very distinct pest throughout the region in which alfalfa is now a very important crop. So far the species has not been studied sufficiently to suggest any very definite means of control. In case the eggs are deposited in the stems of the alfalfa, a proper timing for the cutting of the crop and the consequent destruction of the eggs would appear to be a very feasible method of control. This would seem to be a very essential point for determination and one which should be easily determined in the localities where the species is of especial consequence.

Another species which is of very general distribution is *Stictocephala inermis*, which has been taken throughout a considerable range of the northern part of the United States, and which seems to occur under somewhat similar conditions as *festina*. There is so far not as definite a mass of evidence with regard to its occurrence on a particular crop, but it quite certainly is able to feed upon alfalfa and clover, and very probably may become very important to this crop.

Another species of wide extent and distribution in the northeastern part of the United States is *Stictocephala lutea*. This species apparently has a rather general distribution in food habit, being taken from a considerable variety of plants, and so far it seems impossible to assign it to any one as a favorite. It is, however, a quite abundant species, being found in swarms in some instances in very small areas, and in such cases must be a sufficient menace to be worthy of investigation. The range of this species seems to fit fairly well to the distribution of *festina*, being common from Georgia northward through the Northern States to Canada, its southern boundary agreeing in a somewhat general way with the northern boundary of *festina* in the eastern part of its range.

Other species of the genus are found in Southern, Southwestern Pacific States, but so far, they have been observed only in limited and numbers.

While the information about the habits, life histories, etc., of these species is still rather limited, it seems quite desirable that this information should be brought together, that the attention of workers in different parts of the country may be centered upon these as possible serious pests, and definite knowledge acquired so that whatever may be done in the direction of suppression may be adopted in proper season.

President Sanderson: Is there any discussion of this paper?

Mr. R. L. Webster: I would like to ask Professor Osborn where the eggs are laid.

Mr. Osborn: We should find them in the tissues of the stems of the plant. I would not want to make a general statement, but there is where we look for them.

Mr. R. L. Webster: I have found them in the woody tissues of the apple. I suspect they might lay their eggs in various places. As I remember, in this case I bred the larvæ on apple and they deposited eggs in the woody tissue.

Mr. Osborn: I might add that there are some species of *Ceresa* which act in very much the same manner as *Stictocephala*.

President Sanderson: The next paper on the program is by Professor Washburn on "Methods of Securing the Fertilization of Clover by Means of Bumblebees, in Experiments with *Bruchophagus funebris*."

A METHOD OF SECURING THE FERTILIZATION OF CLOVER BY MEANS OF BUMBLEBEES, IN EXPERIMENTS WITH BRUCHOPHAGUS FUNEBRIS

By F. L. Washburn, *St. Anthony Park, Minn.*

At the very beginning of work on the life history of *Bruchophagus* we found it necessary to secure clover seed properly fertilized and yet immune from insect attack. This, as we discovered, was a most difficult thing to accomplish. For two years we tried in vain to do this by hand pollination, the work being begun by Mr. Ruggles, and continued by Doctor Franklin. Naturally, we were discouraged. I am happy to say, however, that this year, by the method described here, we have succeeded in this very essential matter, and have had no trouble in securing fertilized seed, suffering in no way from insect attack, and thus forming a basis for investigations on the life history of the insect in question. As stated above, the work was begun over

two years ago by Mr. Ruggles, later joined by Doctor Franklin. We have recently added to our force, under the provisions of the Adams Act, Mr. Theodore Urbahns, who is, at present, giving his entire time to this problem. Mr. Urbahns has invented a cage which seems to answer the purpose for which it was intended excellently well. This cage is made of a wooden frame, covered with white cheese cloth on three sides and on the top. A loose glass plate forms the fourth side. The floor is of wood, perforated in the center in such a way as to allow clover heads from two or more plants to be introduced into the cage. The cage is suspended over the growing plants. The perforations through which the clover heads are introduced can be shut to exclude other insects, and to keep the clover stems in place, by means of two wooden shutters.

The method of procedure in securing the cross pollination of the florets has been to confine the green heads in other cages, made of mica lamp chimneys closed at the top with a piece of cheese cloth, and at the bottom with a fold of the same kind of cloth, which can be firmly tied around the stem bearing the introduced head. This cage is held in place above a plant by a cord from above and below. This latter apparatus was suggested in an article by C. E. Hood in the April, 1909, number of the JOURNAL OF ECONOMIC ENTOMOLOGY. Of course, these heads might have been covered with cheese-cloth bags, but in that case could not have been so easily watched. When the florets open and are ready for pollination, they are removed from the mica cages and introduced into the cage made by Mr. Urbahns, and described above. Into this cage, one or two bumblebees are introduced, and we found that early in the season the bees worked faithfully every day, after becoming accustomed to their prison, occasionally as long as three weeks. Later in the season their work was not quite so satisfactory, but when captured early in the morning they usually worked well for a few hours, after which time they were liberated. When these clover blossoms have been thoroughly gone over by the bees, they are removed from the pollenizing cage, and again placed in the mica cages for future use in *Bruchophagus* studies.

At the close of this paper Dr. A. F. Woods, dean of the College of Agriculture of the University of Minnesota was introduced by the President.

DEAN WOODS: I do not like to break into this program, but I wanted to come up and see some of the familiar faces, and welcome you to this branch of the university. I think we have a very high

appreciation of entomology here, and have a corner on that subject so far as the university is concerned. This institution opens its arms to you—every door and every place you want to go into is yours.

PRESIDENT SANDERSON: The next paper will be given by Mr. George A. Dean, Manhattan, Kan., on "Fatal High Temperatures for the Control of Mill Insects."

HEAT AS A MEANS OF CONTROLLING MILL INSECTS[1]

By GEORGE A. DEAN, *Manhattan, Kan.*

In connection with investigations relative to the inspection and fumigation of flour mills, the writer noticed on several occasions that the common mill insects were dead, although they were surrounded with an abundance of food. Upon further investigation it was observed that these insects were most frequently found dead in those parts of the mill where, owing to the surrounding conditions, they could easily have been subjected to a temperature varying from 105° to 120° F. for four or five hours per day and for a period of several days.

On looking over available literature relative to the control of this class of insects, it was found that the French long ago knew the value of heat and devised contrivances, called insect mills, for the heating of infested grain. Experiments made by Prof. F. M. Webster in 1883 to ascertain the amount of heat required to destroy the Angoumois grain moth gave these results, "a temperature of 140° F., continued for nine hours, literally cooks the larvæ or pupæ. A temperature of 130° F., for five hours, is fatal, as is also 120° for four hours, while 110° applied for six hours was only partially effective." It was also found in his experiments that wheat could be subjected to a temperature of 150° for eight hours without impairing its germinat-

[1]This paper embodies the results of some of the investigations undertaken by the writer in the prosecution of project No. 58, "Insects Injurious to Stored Grain and Stored Grain Products," of the Kansas State Agricultural Experiment Station.

The writer desires to acknowledge the valuable assistance rendered by Mr. R. M. Caldwell in carrying out laboratory experiments, and by Mr. Caldwell and Mr. F. B. Milliken in fumigating various mills with hydrocyanic acid gas, and in making trials of heat as a method of destroying mill insects in the large mill where the practical tests were made.

ing properties. In the second report of the state entomologist of New York, Prof. J. A. Lintner, in speaking of *Tribolium ferrugineum* infesting grain and flour says, "A moderate degree of heat, 120° to 130° F., continued for a few hours, would in all probability suffice to kill all the eggs, larvæ and pupæ in the material, while a higher temperature, perhaps 150° or more, would be needed for the beetles. Prof. F. H. Chittenden in his article on "Insects Injurious to Stored Grain" says, "Prior to the adoption of carbon disulphide as a fumigant, heat was relied upon in the destruction of these insects. A temperature of from 125° to 140° F., continued for a few hours, is fatal to grain insects, and wheat can be subjected to a temperature of 150° for a short time without destroying its germinating power."

Nearly all the experiments of this nature were made relative to the discovery of a method to destroy Angoumois grain moth, and from the results of these experiments some of the experimenters and other writers have assumed that many of the grain insects could probably be destroyed in the same manner, but it would require a higher temperature to destroy the adults than the larvæ or pupæ. Since this method of combating grain insects was not developed and given a practical test in a flour mill, and believing that the death of these insects in the Kansas mills was caused by a fatal maximum temperature, the next step was to determine this temperature and to ascertain whether it would be possible and practical to not only produce such a condition in a modern mill, but whether it would prove fatal to the insects therein.

In the first experiment about twenty-five individuals of both the adult and larvæ of *Tribolium confusum* were placed in a shell vial and covered with an inch of flour. A thermometer was placed in this vial with the bulb resting in the center of the flour. The vial containing the flour and various stages of *Tribolium confusum* was next suspended in a large bottle in such a manner as not to touch the sides of it. This bottle was then placed in a glass jar filled with water, and this glass jar was placed in a vessel filled with water. The heat was applied beneath this vessel. This arrangement reduced to a minimum the unequal distribution of the heat in the shell vial containing the insects. In raising the temperature from 80° to 90° no change was noticed in the action of these insects. At a temperature of about 96° the adults became uneasy and began running around rather rapidly. At a temperature of 100° the larvæ emerged and crawled over the flour, and the adults were running more rapidly than at 96°. At a temperature of 110° both larvæ and adults were frantic and were making every effort to escape, and these actions were continued until a temperature of 115° was reached. At this temperature both the

larvæ and adults were becoming passive, and at a temperature of 118° all adults were lying on their backs apparently dead, while four or five larvæ showed very feeble movements. At a temperature of 119° there was no sign of life; however, the temperature was raised to 120° and then the insects were removed and given a chance to recover, but none did. This experiment was repeated several times and each time as soon as a temperature of from 119° to 120° was reached it proved fatal to all stages of the insects. It required from twelve to fifteen minutes to reach this fatal temperature.

Similar experiments were conducted and repeated with the larvæ, pupæ, and adults of *Silvanus surinamensis*, *Ephestia kuehniella*, *Tenebrioides mauritanicus*, and the adults of *Calandra oryza*. As soon as a temperature of 116° was reached it proved fatal to the adults of *Ephestia kuehniella* while it required a temperature of 118° to prove fatal to the larvæ and pupæ. A temperature of 118° was fatal to the adults of *Calandra oryza*, and a temperature of 119° proved fatal to all stages of *Silvanus surinamensis*. At a temperature of 120° the majority of the *Tenebrioides mauritanicus* perished, but it required a temperature of 120° for a period of three minutes to prove fatal to all.

In a second series of experiments a paraffin oven or incubator was used, and after the oven was heated to a required temperature, the insects were placed in it and the oven held to a constant temperature throughout the experiment. In this experiment about twenty-five specimens of the eggs, larvæ, pupæ and adults of *Tribolium confusum*, larvæ and pupæ of the *Ephestia kuehniella*, and the adults of *Calandra oryza*, and *Tenebrioides mauritanicus* were used. Experiments were made not only with these various stages of insects on top of the flour, but one and two inches below the surface. After a series of experiments it was found that a temperature of 115° for a period of twelve hours proved fatal to all the insects in their various stages.

Since in practical use it would be impossible to actually heat a mill in a few minutes as in the first series of experiments, or subject them to such a sudden change as in the second series, a third set of experiments was conducted to determine the fatal temperature under conditions that could actually be produced in a mill. In these experiments the larvæ, pupæ, and adults of *Tribolium confusum*, the adults of *Silvanus surinamensis*, and *Ephestia kuehniella* were used. The various stages of the different insects were placed in shell vials, so that their actions under the slowly rising temperature of the oven could be observed. The heat was applied at 8 a. m. and the temperature noted at intervals of every half hour. The temperature at the

Chart Showing Rise of Temperature in Paraffine Oven.

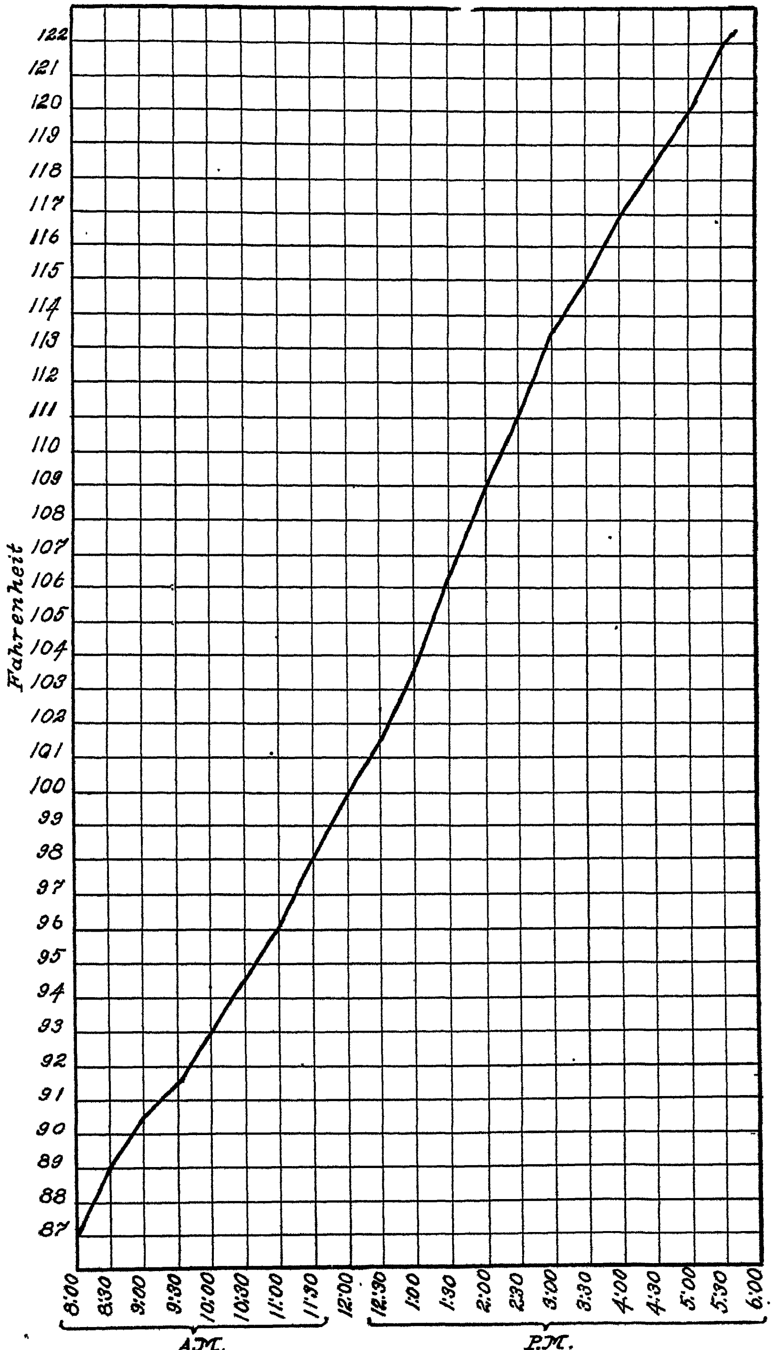


Chart I

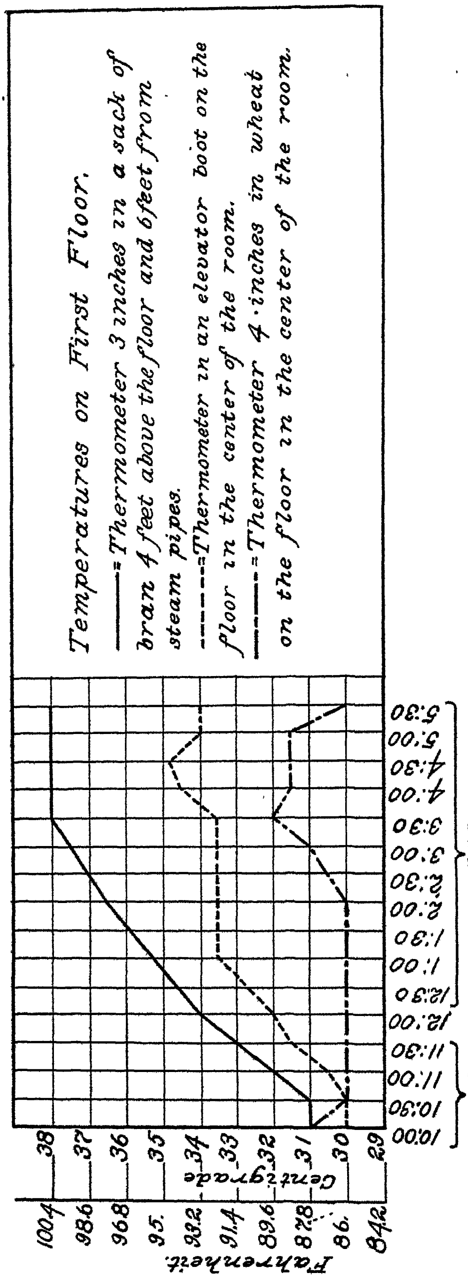

Temperatures on First Floor.
= Thermometer 3 inches in a sack of bran 4 feet above the floor and 6 feet from steam pipes.
= Thermometer in an elevator boot on the floor in the center of the room.
= Thermometer 4 inches in wheat on the floor in the center of the room.
Centigrade
38
37
36
35
34
33
32
31
30
29
Fahrenheit.
100.4
98.6
96.8
95.
93.2
91.4
89.6
87.8
86.
84.2
10:00
10:30
11:00
11:30
12:00
12:30
1:00
1:30
2:00
2:30
3:00
3:30
4:00
4:30
5:00
5:30
A.M.
P.M.

Chart II

time the insects were placed in the incubator was 87°, or the same as the temperature of the place from which they were taken. The behavior of the various insects as the temperature gradually increased was most interesting. At 10.45 a. m., with a temperature of 95°, the larvæ and adults of *Tribolium confusum* began to appear uneasy, and their uneasiness increased rapidly with the rise of temperature. At 11.45 a. m. with a temperature of 99°, the adults of *Ephestia kuehniella* began to move and fly about with the same uneasiness. At 2.15 p. m. with a temperature of 110°, all stages of the different insects were most active and were making every effort to escape the heat. Even the pupæ were wriggling and struggling. At 3.45 p. m., with a temperature of 116.5°, the first adult of *Ephestia kuehniella* died, and at 4.30 p. m., with a temperature of 118.5°, all the moths were dead, and a few of the adults and larvæ of *Tribolium confusum.* At 5.15 p. m., with a temperature of 121°, all of the *Silvanus surinamensis* were dead, but two adults and five larvæ of *Tribolium confusum* were alive. At 5.30 p. m., with a temperature of 122°, two larvæ of *Tribolium confusum* were still alive, but these died eleven minutes later at a temperature of 122.5°. In this experiment fifteen insects of each stage were used. (Chart I.)

The Heat Method Put to a Test in a Modern Mill

Since the laboratory experiments demonstrated that this class of insects could be destroyed at a temperature not beyond that which could actually be produced within a modern mill, a flour mill was selected for a practical test. This mill had heavy brick walls and tight wooden floors. It had no basement, was four stories high, all stories were heated with steam, and were well filled with machinery. The packers, elevator boots, and pulley machinery were on the first floor; the rolls were on the second floor, and the purifiers, sifters, and bolters were on the third and fourth floors. It had a daily capacity of 600 barrels, and in its construction represented the average modern mill in the state of Kansas. The first floor, 38 feet wide, 63 feet long, and 12 feet high, with a capacity of 28,728 cu. ft., was heated by eight one and one-half-inch steam pipes, the radiating surface of which was 515 sq. ft. These pipes were arranged in eight coils near the ceiling along the two sides and across one end of the room. The pipes were placed near the ceiling in order not to obstruct the doorways. The second floor, the capacity of which was the same as that of the first, had one coil less of the steam pipes with a radiating surface of 450 sq. ft., but these seven coils were placed near the floor along the side walls and across one end. The third floor which was

13 feet high and with a capacity of 31,122 cu. ft. had six coils with a radiating surface of 386 sq. ft., and these were placed the same as those on the second floor. The fourth floor which was 18 feet high and with a capacity of 43,092 cu. ft., had only five coils with a radiating surface of 322 sq. ft. These pipes were arranged like those on the second and third floors.

TABLE SHOWING THE DIMENSIONS AND HEATING SYSTEM OF THE MILL

Floor	Dimensions	Capacity in cu. ft.	No. of coils of steam pipes	Diam. of steam pipes (in.)	Linear feet of steam pipes	Radiating surface of steam pipes (sq. ft.)	Location of steam pipes	Remarks
1	38 x 63 x 12	28,728	8	1½	1,312	514.96	Near ceiling	
2	38 x 63 x 12	28,728	7	1½	1,148	450.59	Near floor	There were no steam pipes across one end of each floor
3	38 x 63 x 13	31,122	6	1½	948	386.22	Near floor	
4	38 x 63 x 18	43,092	5	1½	820	321.85	Near floor	
	Total	131,670	26		4,264	1,673.62		

This mill was badly infested with all stages of *Tribolium confusum*, and slightly infested with several of the other common mill insects. In the first experiment no change of any sort was made in the heating system. Four thermometers were distributed on each floor in such a manner as to get the temperature not only in the open, but in different depths of flour, and in accumulations in different parts of the room. At 10 o'clock a. m., August 21, with the mill just as it had been shut down for Sunday, the steam was turned into the pipes, and since this mill was ordinarily heated with exhaust steam, the live steam had to be forced through the exhaust pipe, which prevented it from having more than two or three pounds pressure. The heat was applied from 10 a. m. to 5.30 p. m., and the temperatures of all the thermometers noted at intervals of every half hour. Although the day was very warm, reaching a maximum temperature of 95°, and the average temperature of the mill before the heat was applied was 89°, yet the mill did not heat rapidly, and by 5 o'clock there were only two or three places in the mill where a fatal temperature had been reached. On the first floor the highest temperature was 100.4°, while one thermometer in the bottom of an elevator boot registered only 94°.

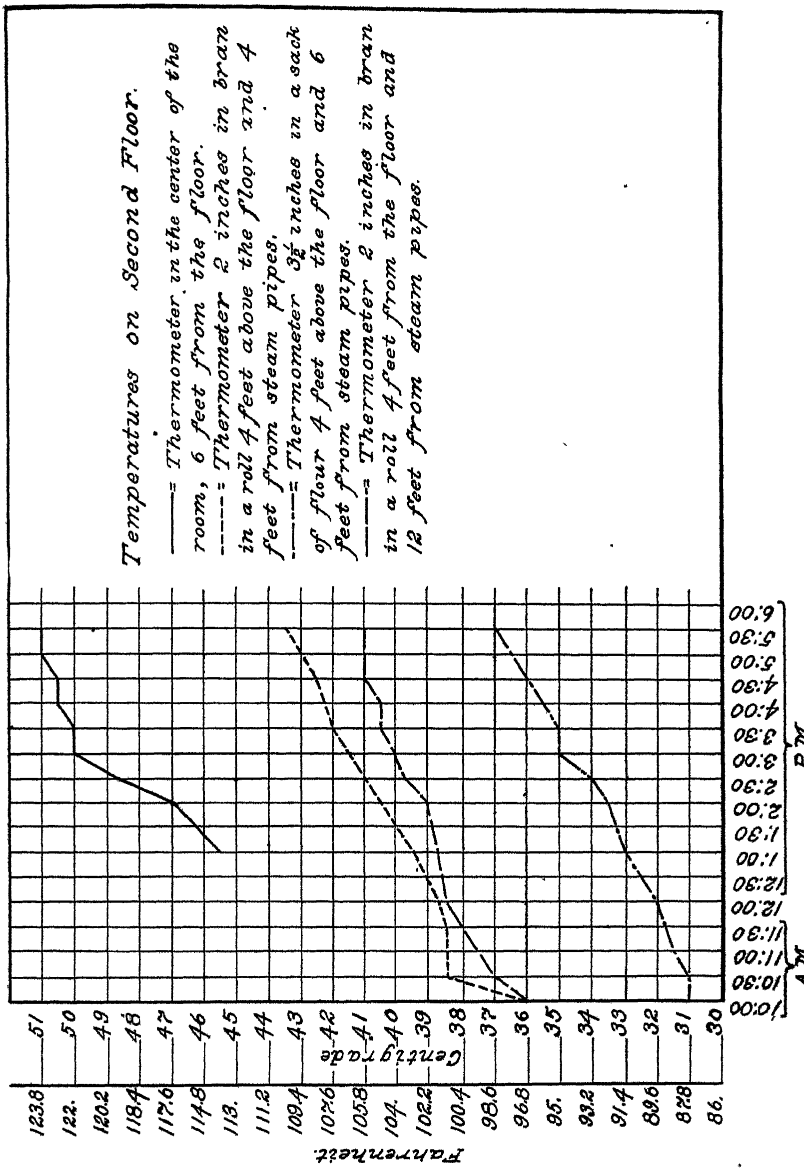

Temperatures on Second Floor.
——— = Thermometer in the center of the room, 6 feet from the floor.
- - - - = Thermometer 2 inches in bran in a roll 4 feet above the floor and 4 feet from steam pipes.
-·-·- = Thermometer 3½ inches in a sack of flour 4 feet above the floor and 6 feet from steam pipes.
——— = Thermometer 2 inches in bran in a roll 4 feet from the floor and 12 feet from steam pipes.
Centigrade
Fahrenheit
A.M.
P.M.

Chart III

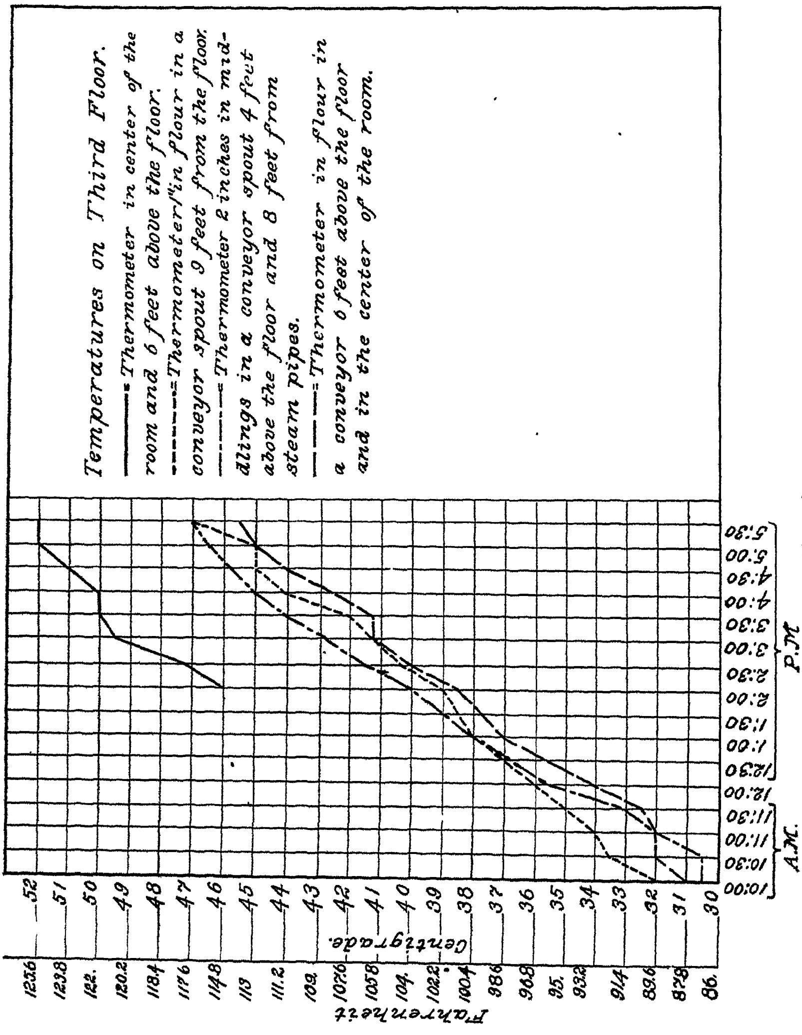

Temperatures on Third Floor.
——— = Thermometer in center of the room and 6 feet above the floor.
- - - - - = Thermometer 1" in flour in a conveyor spout 9 feet from the floor.
— · — · — = Thermometer 2 inches in middlings in a conveyor spout 4 feet above the floor and 8 feet from steam pipes.
— — — = Thermometer in flour in a conveyor 6 feet above the floor and in the center of the room.
Centigrade.
Fahrenheit
A.M.
P.M.

Chart IV

(Chart II.) On the second floor the highest temperature, 123.8°, was registered by the thermometer hanging in the open, while the lowest temperature, 98.6°, was registered by a thermometer three and one-half inches in a sack of flour four feet above the floor. (Chart III.) On the third floor the thermometer in the open registered 125.6°, and the lowest temperature, 114°, was registered in a flour conveyor six feet above the floor. (Chart IV.) On the fourth floor the thermometer in the open registered 118.4°, and the lowest temperature, 107.6°, was registered by the thermometer two inches in flour in a conveyor near the floor. (Chart V.)

A hydrograph was placed on the second floor in the middle of the room. The relative humidity of this floor at 10 a. m., or just as the heat was applied was 93 per cent. From 10 a. m. to 12 m. there was a rapid decrease to 40 per cent, and from 12 m. to 5.30 p. m. there was a gradual decrease to 27 per cent.

Although the temperatures reached were disappointing, and no insects were killed on the first floor, yet on the third floor fully one third of the insects perished, and on the fourth floor about one fourth succumbed to the heat. Even the second floor showed that many insects had perished. The experiment proved the following: More time must be taken to reach the desired temperature; this temperature should be held several hours to allow the heat to penetrate all of the infested parts; there should be a water trap to draw off the water accumulated in the steam pipes; the steam should be turned on with some pressure so as to heat the mill more rapidly; the steam pipes should be near the floor in order to heat the room.

In the second experiment, made three weeks later, two changes were made in the heating system. A water trap was attached and arrangement made to turn the steam on directly and with pressure. The arrangement of the pipes in the mill was not altered. At 6 a. m., September 11, the mill was shut down and, after the thermometers were distributed as in the first experiment, the steam was turned on with ten to twelve pounds pressure. The heat was applied from 6 a. m., until 6 a. m. the day following, and the temperature of the sixteen thermometers noted at intervals of every half hour, save in a few cases when the readings were made at intervals of one hour. The average temperature in the mill at the time the heat was applied was about 90°, and the mean temperature during the day outside of the mill was 77°.

In nearly all parts of the mill the temperatures gradually increased, and at 3 o'clock p. m. fatal temperatures were reached in several parts. At 6 o'clock p. m. many of the insects had perished. At 9 o'clock p. m. fatal temperatures were indicated by nearly all the

thermometers except on the first floor. However, realizing that it required time to heat through heavy machinery and to penetrate into several inches of flour, the heat was continued until 6 a. m., by which time it had penetrated the innermost recesses of the mill, save the first floor. On the first floor the highest temperature was 105°, while one thermometer in four inches of wheat near the floor registered only 96°. (Chart VI.) On the second floor the highest temperature, 133.5°, was registered by a thermometer hanging in the open, while the lowest temperature, 117.6°, was registered by a thermometer three inches in a sack of flour three feet above the floor. (Chart VII.) On the third floor the thermometer in the open registered 141°, and the lowest temperature, 129°, was registered in a flour conveyor spout four feet above the floor. (Chart VIII.) On the fourth floor the thermometer in the open registered 128.6°, and the lowest temperature, 118°, was registered by a thermometer in flour in a conveyor six feet above the floor. (Chart IX.)

The hydrograph was placed on the second floor in the middle of the room. The relative humidity of this floor at 6 a. m., or just as the heat was applied, was about 72 per cent. During the first few hours there was a rapid decrease to less than 40 per cent, and during the afternoon and through the entire night there was a very gradual decrease to 12 per cent.

After a very careful examination of the three upper floors, all parts of the mill, even the deepest accumulations in the most inaccessible parts, failed to show live insects, save in one corner on the upper floor. In several places where there were accumulations inaccessible to hydrocyanic acid gas, the conveyor or the bins were torn open, and after being carefully inspected, did not reveal a live insect, but showed that thousands had perished. In a sample room on the third floor there were hundreds of samples of grain in paper and cloth bags, tin cans, and sealed glass jars. These were badly infested; but all of the insects were killed by the heat. On the fourth floor there was a large flour conveyor running the entire length of the mill, and in this conveyor the accumulation of flour which was from three to five inches in depth was badly infested, but, after tearing it open from one end almost to the other, it was found that all of the insects had perished. Nearly three weeks later a second examination was made of the mill and no live insects of any sort were found above the first story.

In a mill, flour accumulates in recesses, and insects breed in places inaccessible to the gas or vapor of any fumigating material, but heat passes through all of these obstructions and penetrates the innermost recesses. The writer has fumigated many mills with hydrocyanic acid gas, but in no case has the fumigation proved so successful as

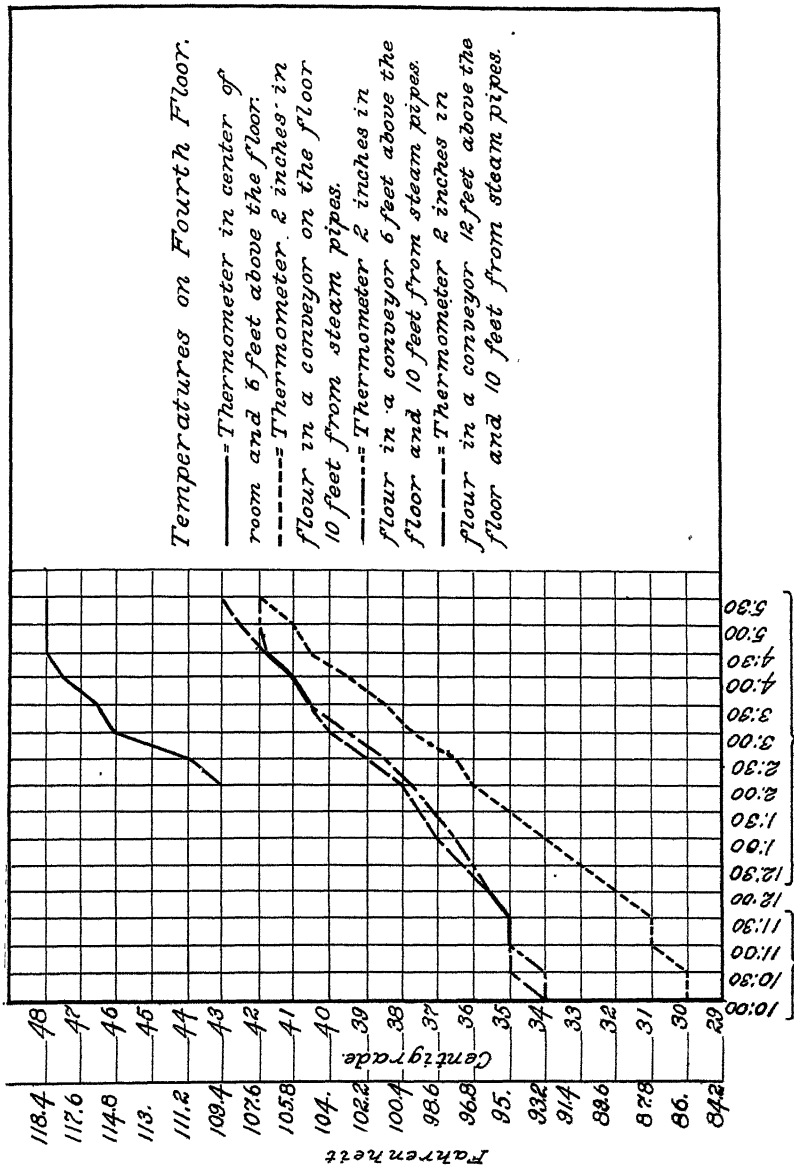

Temperatures on Fourth Floor.
——= Thermometer in center of room and 6 feet above the floor.
- - - -= Thermometer 2 inches in flour in a conveyor on the floor 10 feet from steam pipes.
-·-·-= Thermometer 2 inches in flour in a conveyor 6 feet above the floor and 10 feet from steam pipes.
——= Thermometer 2 inches in flour in a conveyor 12 feet above the floor and 10 feet from steam pipes.
10:00
10:30
11:00
11:30
12:00
12:30
1:00
1:30
2:00
2:30
3:00
3:30
4:00
4:30
5:00
5:30
A.M.
P.M.
Centigrade
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
Fahrenheit
118.4
117.6
114.8
113.
111.2
109.4
107.6
105.8
104.
102.2
100.4
98.6
96.8
95.
93.2
91.4
89.6
87.8
86.
84.2

Chart V

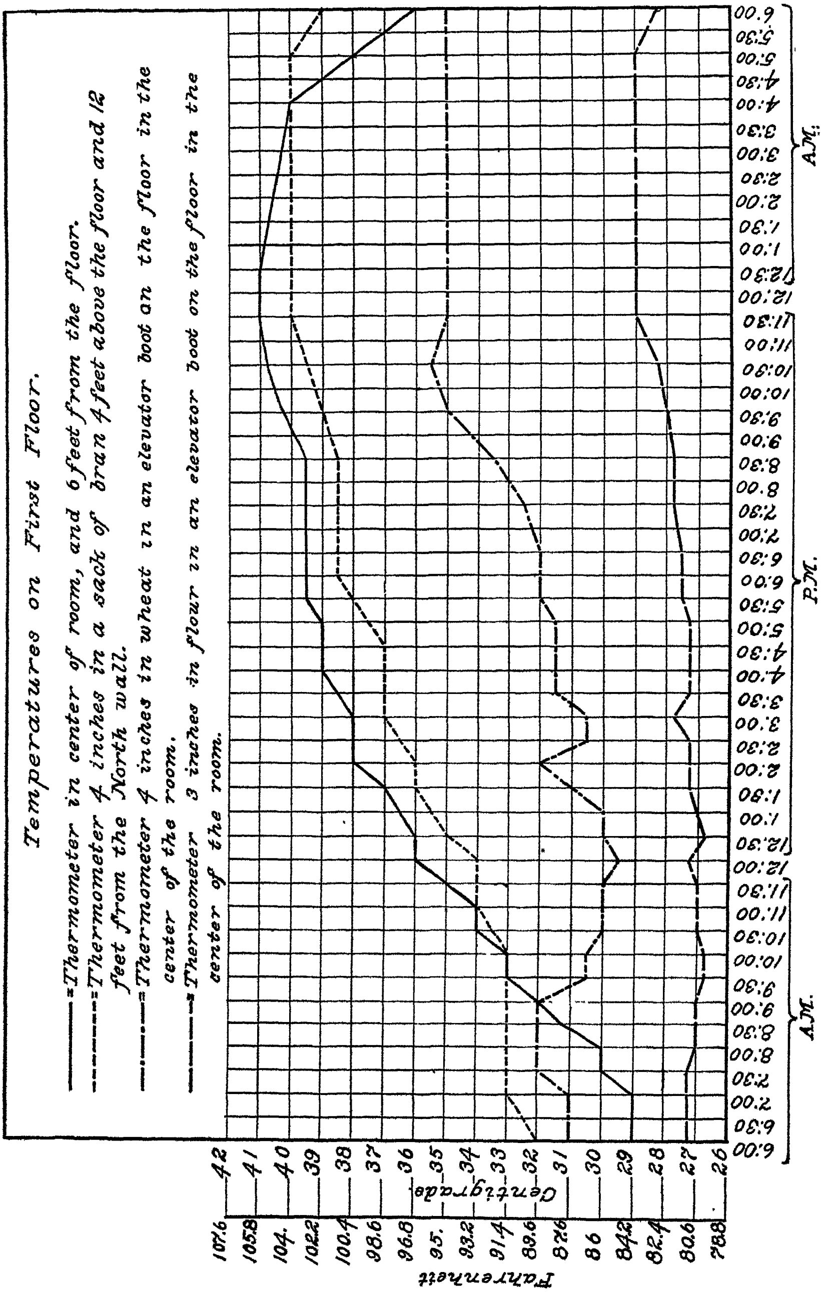

Temperatures on First Floor.
——=Thermometer in center of room, and 6 feet from the floor.
- - - -=Thermometer 4 inches in a sack of bran 4 feet above the floor and 12 feet from the North wall.
—·—·—=Thermometer 4 inches in wheat in an elevator boot on the floor in the center of the room.
—··—=Thermometer 3 inches in flour in an elevator boot on the floor in the center of the room.
Centigrade
Fahrenheit
A.M.
P.M.
A.M.

Chart VI

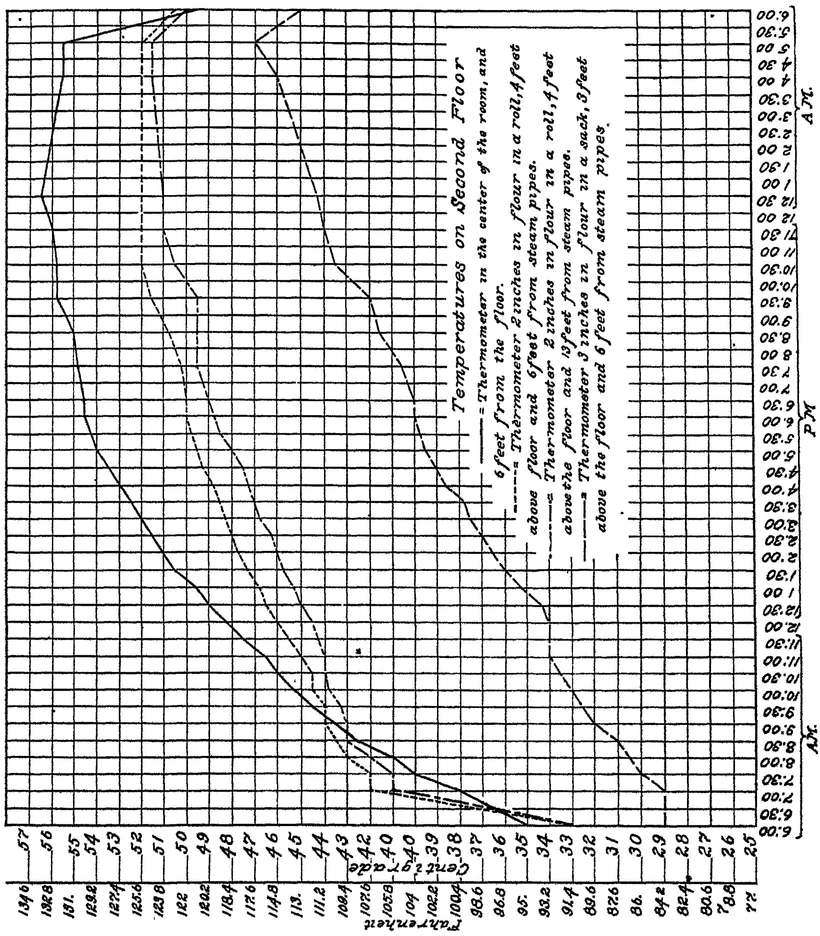

Temperatures on Second Floor
= Thermometer in the center of the room, and 6 feet from the floor.
= Thermometer 2 inches in flour in a roll, 4 feet above floor and 6 feet from steam pipes.
= Thermometer 2 inches in flour in a roll, 4 feet above the floor and 13 feet from steam pipes.
= Thermometer 3 inches in flour in a sack, 3 feet above the floor and 6 feet from steam pipes.
Centigrade
Fahrenheit
A.M.
P.M.
A.M.

Chart VII

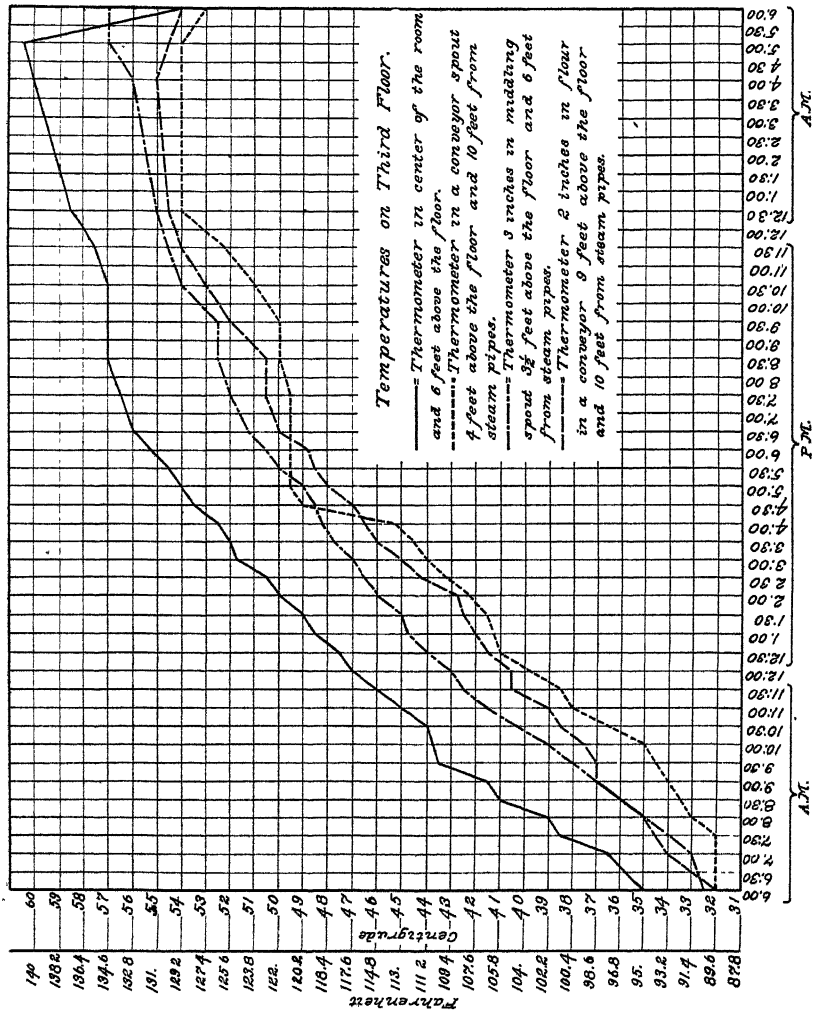
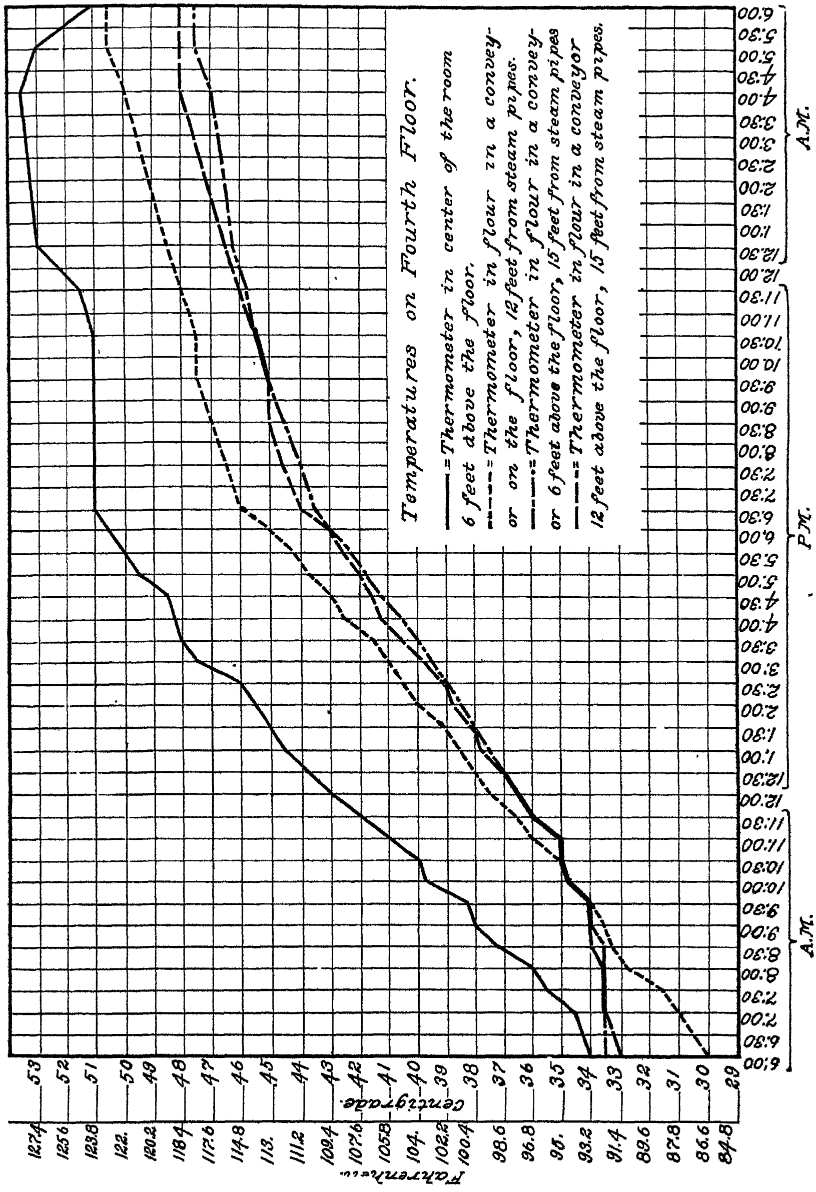

Temperatures on Third Floor.
= Thermometer in center of the room and 6 feet above the floor.
= Thermometer in a conveyor spout 4 feet above the floor and 10 feet from steam pipes.
= Thermometer 3 inches in middling spout 3½ feet above the floor and 6 feet from steam pipes.
= Thermometer 2 inches in flour in a conveyor 9 feet above the floor and 10 feet from steam pipes.
Centigrade
Fahrenheit
A.M.
P.M.
A.M.

Chart VIII


Temperatures on Fourth Floor.
= Thermometer in center of the room 6 feet above the floor.
= Thermometer in flour in a conveyor on the floor, 12 feet from steam pipes.
= Thermometer in flour in a conveyor 6 feet above the floor, 15 feet from steam pipes
= Thermometer in flour in a conveyor 12 feet above the floor, 15 feet from steam pipes.
Centigrade.
Fahrenheit.
A.M.
P.M.
A.M.
6.00
6.30
7.00
7.30
8.00
8.30
9.00
9.30
10.00
10.30
11.00
11.30
12.00
12.30
1.00
1.30
2.00
2.30
3.00
3.30
4.00
4.30
5.00
5.30
6.00
53
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
127.4
125.6
123.8
122.
120.2
118.4
117.6
114.8
113.
111.2
109.4
107.6
105.8
104.
102.2
100.4
98.6
96.8
95.
93.2
91.4
89.6
87.8
86.6
84.8
Chart IX

the heating of this mill, and in this case with a few alterations in the arrangement of the steam pipes, and with some additional radiating surface, this would be the most efficient, convenient, and least expensive method. To fumigate with hydrocyanic acid gas, requires from two to three days, and this long shut-down, with the additional cost of material, is a large item of expense besides being dangerous to the life of the operator, while with the heat, since it can be applied from Sunday morning until Monday morning, there is no loss of time, very little expense, and no danger to the life of the operator.

PRESIDENT SANDERSON: Any discussion?

MR. WASHBURN: You do not mention anything about the eggs of *Ephestia*.

MR. DEAN: This mill was not infested with the Mediterranean flour moth.

MR. WASHBURN: But you do not know whether you can free a mill of eggs by this method.

MR. DEAN: Since this mill showed no live insects three weeks later, I believe all eggs were killed in the upper stories.

MR. WASHBURN: Then there are enough eggs in the lower story to restock the entire mill.

MR. DEAN: The point is this, Professor Washburn, if those pipes had gone down to the lower floor we could have had as high temperatures there as on the upper floors.

MR. WASHBURN: Have you tried it in the winter time in Kansas?

MR. DEAN: No. In the second experiment the temperature was 77° outside.

MR. WASHBURN: My point is this, with the method of piping in a mill, that in the winter it would be hard to get the temperatures required in the lower stories.

MR. DEAN: All the mills would have to put in more radiation, but that would cost less than shutting down for fumigation two or three days.

MR. WASHBURN: In fumigating with hydrocyanic acid gas they only shut down from Saturday night to Sunday morning. They do it when they are cleaning the mill, and part of the cleaning process with many millers is fumigating with hydrocyanic acid gas.

A MEMBER: I find that the employees in mills undertake fumigation with hesitancy.

MR. DEAN: I have heard men state that they would quit the job before they would touch it. In the case of fumigation the mill has

to be cleaned out, and prepared for fumigation, but with this other method it is not necessary to clean out the accumulations and some millers state that they would rather spend $2,000 or $3,000 for heating apparatus than to spend $500 or $600 every year for fumigation.

MR. WASHBURN: It seems to me that this is a most excellent paper. At the same time I do not see how they estimate the expense of fumigating at such a high figure because the material is not very expensive.

MR. DEAN: When you use 1,500 pounds of cyanide the material counts up, to say nothing of the two or three days shut down.

MR. WASHBURN: In Canada in a very large mill, we used a ton of material, but even that expense would have been trebled if they had to pipe the mill. Of course, if you can reach *Tribolium* buried two, or three, or four inches in flour, you have done a good work. The gas would not go through a sack of bran.

MR. DEAN: They removed a large roll and the insects were killed in the accumulation back of the machinery which was two inches thick.

MR. WASHBURN: Some millers have a wrong idea as to hydrocyanic acid gas. I have run to earth four or five stories of men killed by accident. One or two men have been killed by bisulfid of carbon, but I have yet to find a single individual killed by hydrocyanic acid gas. Several men, to my knowledge, use this once or twice a year, when they clean, but they never successfully reach *Tribolium*, that insect is so insidious, and if heat will do it, it is a good thing.

MR. HEADLEE: I cannot forbear raising the question as to whether, if the mills are tight and properly heated during the summer season, and all the insects killed, there would be any necessity for heating during the winter.

MR. LOWE: The point which interested me particularly in this paper presented by Mr. Dean, is the fact that the insects were killed in the sealed container. I have a mill and big seed store placed at my disposal, and I have been experimenting with a new product which we have, but have not obtained any good results, particularly in the spouts, and in the inaccessible parts, but I shall now test the idea Mr. Dean has brought out and hope by our next meeting to bring some corroborative results.

MR. WASHBURN: I would like to ask Mr. Dean if this method will kill the eggs.

MR. DEAN: In the experiments in the laboratory where it required from 8 in the morning until 5 o'clock in the afternoon to reach the high temperature, we had eggs and larvæ, and the eggs perished before the larvæ. Eggs subjected to a temperature of 120° for fifteen minutes were killed. It takes a longer time to penetrate mill products.

MR. WASHBURN: I was thinking of the spouts, elevators, etc.

MR. DEAN: If the egg is subjected to a temperature of 120° it perishes in a short time.

MR. WASHBURN: No injury to mill products?

MR. DEAN: None.

MR. LOWE: Do the insects leave the flour when they are about to die?

MR. DEAN: I will say this, I saw a great many dead insects on the floor. They became uncomfortable and rushed out into the hot air. They did not get far and never reached the window and many times did not go four or five inches.

MR. SMITH: This promises to be a very beneficial and useful method, and it occurs to me that in large stores which frequently have insect pests, if this method was available it would be a blessing, especially to tobacco factories and the like. I should like to ask Mr. Dean if he has made any experiments outside of mills, and on other insects.

MR. DEAN: The experiment was tried only on the five mill-insects stated in the paper. Of course, these experiments are going to be continued.

MR. SANBORN: I would like to ask Mr. Dean if he thinks this method might not be of considerable importance in the treatment of nursery stock for San José scale.

MR. DEAN: I can say nothing definite on this phase of the subject, but simply make the assumption that I cannot believe any insect is going to stand very much heat.

MR. SHAFER: I think the last statement by Mr. Dean is very true. In histology one of the very best methods of fixing insects is by heat. You can fix the parts of an insect quicker by heat, perhaps, than by any other method that has yet been found. If you go above 150° you get the tissues fixed all the way through and if you do that, of course, you kill the insect. Another point, in regard to the penetration of hydrocyanic acid gas: In the work we had to do with that gas we had a little thing come up, which shows why the gas does not penetrate. I took the percentage of gas in a certain amount of air at the beginning of the experiment, and at the end and found the last precentage of the gas very low. It would fall very rapidly, and if I had 77 per cent in a half hour it might fall to 5 per cent, that is the gas was reducing rapidly—the higher precentage of gas the more rapidly it would fall. Now, if you had some substance like flour which contains moisture, it would be taken up by that moisture, and I think these two reasons would account for the fact that the gas does not penetrate. In the case of carbon bisulfid my experience has been that it does not reduce at all, and I believe, if given time, it would go through.

Mr. Smith: I think that every person who has been West knows that there are some spots on the Pacific coast where it is so hot that it actually bakes the scales on the trees.

Mr. Sanders: I would like to ask Mr. Dean if he has had any objection from millers in respect to danger from fire.

Mr. Dean: I will state that where this experiment was conducted there was one of the most intelligent millers I ever met, and it was his opinion that you could go up to 150° or 160° without danger. No oil waste should be left in the mill. You do not have to go up to a temperature of 150°,—130° is plenty high enough.

Mr. Washburn: You would have to convince the insurance company, probably, that there was no danger. They refuse to allow the use of carbon bisulfid, and I suppose they would possibly object to heat.

Mr. Dean: As you say, there is a chance for an objection there, but we can easily prove what the combustion point is. Carbon bisulfid is out of the question in a mill. It does not go up where the flour moth is. With hydrocyanic acid gas in the laboratory we killed the eggs in three inches of flour by subjecting them to the same strength as in the mill, but at three and a half inches some escaped. The larvæ of Tribolium perished at four inches.

President Sanderson: I should like to ask Mr. Dean if he has looked into the matter as to whether these insects exist in the mills in southern Arizona.

Mr. Dean: I have not investigated that at all, but I do not know of any mills in Arizona.

President Sanderson: I am sure we have all been intensely interested in this paper. It is particularly so to me, and I am sure that if heat will destroy these insects, it will destroy others. We will now have a paper by Mr. S. J. Hunter.

THE GRIESA RESEARCH FELLOWSHIP IN ENTOMOLOGY AT THE UNIVERSITY OF KANSAS

An Announcement by S. J. Hunter

Mr. W. S. Griesa, proprietor of Mt. Hope Nurseries, Lawrence, Kan., has established the Griesa Research Fellowship in Entomology in memory of his father, the late A. C. Griesa. In establishing this fellowship it was the wish of the founder that the holder should devote himself to a fundamental investigation of one of the several entomological problems ever present with nurserymen.

Upon consultation, it was decided to select for the theme of this research the Woolly Aphis. Mr. H. W. Lohrenz, A. B., McPherson College, and a graduate student at the University of Kansas, was elected by the regents of the university to this fellowship.

The purpose of this research is, after careful experimentation in remedy and prevention, and investigation into the life cycle of this Aphis, to devise a practical means whereby nurserymen can properly deal with this economic problem in such a way as to eliminate the losses now attending the existence of this insect on nursery stock.

The Fellow assumed this work June 15th last, too late to take up the consideration of subterranean stages. In the following preliminary account, therefore, he deals only with the first series of experiments on summer conditions.

It is worthy of note as showing the interest of nurserymen generally in foundations of this nature that the Western Nurserymen's Association, an organization of nurserymen of the Middle Western States, passed resolutions commending the founder of this fellowship for the work he has instituted.

THE WOOLLY APHIS, SCHIZONEURA LANIGERA

By H. W. Lohrenz, *Griesa Research Fellow, University of Kansas*

Field Experiments

First Series

On July 25 twelve plats were marked off with stakes on a block of apple seedlings. All of these were infested with Aphis. The next day, July 25th, these were sprayed, with the exception of plat No. 10. The solution used was a 15 per cent kerosene emulsion. A few inches of soil was removed, and the bases of the trees and the ground about them was thoroughly moistened.

On August 4 plats Nos. 1, 2, 3, 5, 6, 8, 9, 10, and 11 were examined, plats Nos. 4, 7, and 12 were not examined. One live Aphis was found on a root in plat No. 9. In plat No. 10, which had not been sprayed, the Aphis were present in great numbers. The trees in the sprayed plats seemed to be unaffected by the spray and looked as healthy as any in the block.

Plat No. 12 was examined on September 10. One of the sprayed trees showed a few Aphis on the stem about four inches above the ground and on the roots. It should be noted that the tops had not been

sprayed. Just next to the sprayed plat there was a seedling with a large colony of the Aphis. The whole plat, including this infested tree, was sprayed again with a 10 per cent emulsion.

About the 20th of October these seedlings were taken up and examined. The results are given below in tabulated form:

Second Series

On August 10 another series of plats was marked off on the same block of apple seedlings, with the numbers 13–27, Nos. 28 and 29 were added later. The ground was too wet for successful spraying, and because of continuous rains further work had to be postponed until fairer weather set in.

As copper sulphate was recommended by some for insects affecting roots it was tried on plats Nos. 24–27, but without results.

On September 10, although the ground was yet quite wet, a 10 per cent kerosene emulsion was used on plats Nos. 13–16, 21 and 22. The Aphis were present in great abundance, both on the tops and on the roots.

Examination on September 24 and October 1 showed that the 10 per cent emulsion under those conditions had only a limited effect on the Aphis.

On October 1 the ground was in fair condition and plats Nos. 14, 15, 21, and 23 were sprayed again with the 10 per cent emulsion.

About the 20th of October these seedlings were lifted and examined; the results are shown below in tabulated form.

Third Series

Plats Nos. 16, 18, 19, 20, 28, and 29 were used in the third series.

The solution used was kerosene emulsion of 15 per cent strength and was applied October 1.

These seedlings were lifted along with the others about October 20, and the results are tabulated below.

All of the above plats, Nos. 1–29, contained only those places which were very badly infested with Aphis. They extended from six inches to five feet along the rows of the seedlings.

TABULATED RESULTS OF SPRAYING WITH KEROSENE EMULSION

First Series

Sprayed with 15 Per Cent Emulsion on July 26th

Number of plat	Per cent of trees infested before spraying	Number seedlings sprayed	Number seedlings free from Aphis	Number infested at present	Number showing knotty effects
1	90	24	24	0	1
2	90	29	28	1	9
4	85	15	15	0	2
5	85	16	16	0	1
7	85	10	10	0	0
8	85	16	16	0	1
9	90	16	12	4	5
11	85	16	15	1	3
12[1]	90	19	18	1	6
Total		161	154	7	28

Second Series

Sprayed with 10 Per Cent Emulsion on September 10 and October 1

Number of plat	Per cent of trees infested before spraying	Number seedlings sprayed	Number seedlings free from Aphis	Number infested at present	Number showing knotty effects
13[2]	70	18	18	0	1
14	90	6	6	0	1
15	90	36	33	3	13
21	90	28	27	1	4
22[3]	90.	10	6	4	2
23[4]	90	20	15	5	8
Total		118	105	13	29

[1]No. 12 was given a second spraying with 10 % emulsion on September 10.
[2]Sprayed only September 10.
[3]Sprayed only September 10.
[4]Sprayed only October 1.

Third Series

Sprayed with 15 Per Cent Emulsion on October 1

Number of plat	Per cent of trees infested before spraying	Number seedlings sprayed	Number seedlings free from Aphis	Number infested at present	Number showing knotty effects
16[5]	90	53	51	2	15
18	90	17	17	0	5
19	90	30	24	6	13
20	90	23	20	3	4
28	90	15	14	1	4
29	90	29	24	5	18
Total		167	150	17	59

Deductions from Above Figures

The first spraying was the most effective. This was due to the fact that the ground was drier, so that the emulsion could soak down to the roots more easily than in the succeeding experiments. Of the total number of trees sprayed, only 87 per cent, or 140 trees were infested. Of these seven showed some Aphis more than two months after the spraying, making 5 per cent infested and 95 per cent freed from Aphis, 20 per cent had become knotty, leaving 80 per cent of the infested stock in good condition for grafting.

Of the trees in the second and third series it must be remarked that at the time of the last spraying, those in the third series were more infested (*i. e.*, each infested tree had a larger number of Aphis) than those in series 2. This difference was due to the fact that the plats in series 2 were sprayed twice, the first time being three weeks before the last spraying.

For the second series, where a 10 per cent emulsion was applied first on September 10 and again on October 1, our figures give a total of 103 infested trees, of which 87.4 per cent were freed from Aphis, leaving 12.6 per cent infested after the spraying; 28 per cent of the infested trees were worthless because of the knotty condition of their roots, leaving 72 per cent to be used for grafting.

Of the 167 trees sprayed with 15 per cent emulsion on October 1 fully 90 per cent, or 150 trees, were at that time infested. Fully 133

[5]No. 16 had been sprayed with the 10 per cent emulsion on September 10, but without any noticeable effects.

No. 17 was a plat not sprayed at all. It contained twenty-two trees; of these, five were free from Aphis, seventeen were infested and seventeen were knotty.

of these, or 88.7 per cent, were freed from Aphis, leaving 11.3 per cent infested. Fully 39.3 per cent were knotty, and only 60.7 per cent could be used for grafting.

The relative value of these three series of experiments can be shown best by the following table:

SUMMARY OF EXPERIMENTS

Number of series	Date of spraying	Strength of emulsion	Per cent of infested trees freed from Aphis	Per cent of trees remaining infested	Per cent of knotty trees	Per cent of trees saved for grafting
1	July 26	15%	95	5	20	80
2	Sept. 10 and Oct. 1	10	87.4	12.6	28	72
3	Oct. 1	15	88.7	11.3	39.3	60.7

A word should be said at this place about the effect of the kerosene emulsion on the roots. None of the seedlings were killed, and the tops showed no ill effects. On examining the roots, however, it was evident that the late spraying had killed a large number of the smaller rootlets and root hairs. These effects were not noticeable on the trees sprayed July 26.

Observations on two-year-old Nursery Stock

The two-year-old apple trees in the nurseries which were examined this summer contained from 20 per cent to 25 per cent infested trees, and several means were tried to free them from Aphis, or at least to prevent further spreading. In one of the nurseries containing about thirty thousand trees kerosene emulsion of 15 per cent strength was applied in a spray. Wherever the spraying was done properly it was quite effective, but no definite figures can be given at this time since the detailed examination will be made in the spring.

At another nursery containing about forty-five thousand trees, the trees had been dust rubbed. When they were taken up in the fall, about 3 per cent were thrown away as worthless because of the effects from Aphis. Of the 318 trees examined in this packing house, thirty-eight were found to have some Aphis. Taking this as a basis, 12 per cent of the stock taken in was infested. Adding to this the 3 per cent thrown away in the field, the infestation in fall has amounted to 15 per cent.

At a third nursery containing about three hundred thousand trees, the trees were rubbed with kerosene emulsion. About 2 per cent

were thrown out in the field. Of 650 trees examined in the packing house sixty were found with Aphis. This gives 9,2 per cent infested, making a total of 11.2 per cent.

NOTES ON FIELD OBSERVATION

About the middle of June the Woolly Aphis was very numerous. In some places from 20–25 per cent of the nursery stock was infested. They were also very numerous on orchard trees of every age. About the end of June the weather grew very warm and dry. As a result the Aphis disappeared, not only the Woolly Aphis of the apple, but many other kinds which had hitherto been very numerous. Very close search on older trees revealed a few on the shady sides under the bark surrounding the scars. It is my opinion that many of the Aphis on the smaller trees and on the nursery stock descend down to the roots at the approach of the summer's heat. Later in the season, as the temperature fell again, the Aphis increased in numbers, and in September there were large colonies. These lasted until the cold weather set in.

Some of the infested nursery stock was sprayed with 15 per cent kerosene emulsion. This killed the Aphis wherever they came in contact with the emulsion, but it is almost impossible to get the emulsion into all the crevices, which are the favored places of the Aphis. Wherever the spraying was done properly the emulsion did not injure the trees, but where too much was put on, it killed the foliage.

Several natural enemies were found to attack the Aphis. One of the parasitic chalcis-flies killed off large colonies in the spring, and for a while it was almost impossible to rear the Aphis in the laboratory, because the parasite had been introduced with stock from the nurseries. This enemy (*Aphelinus mali* Haldeman) was not found in summer and in fall.

In the spring there was also one of the lacewing-flies quite prevalent, the larvæ of which lived on the Woolly Aphis. The larvæ of a syrphus fly was busy not only in the spring, but also in the fall.

NOTES FROM THE LABORATORY

The Woolly Aphis of the apple has no great tendency to wander about and seek new feeding grounds. This seems to be true especially in the spring. At that time I had many apple twigs with Aphis colonies, and in nearly every case the latter perished on the drying twigs. Observations during the month of November show that they are a little more apt to wander in the fall.

Rubbing the trees is a very good method of destroying the Aphis on the tops, especially when care is taken to get into all the crevices. Observation in the laboratory shows that Aphis which are removed while they have their beak in the wood, perish because the beak is broken in most cases. And in no instance did any Aphis so removed establish itself upon the plant again and live.

It takes the young about ten days to come to maturity, during which time it molts four times. In the months of August and September an adult brings forth from two to three young, but the rate of increase seems to be greater in the spring.

The first winged forms were noticed in the laboratory on September 19. During October and the first part of November large numbers of winged forms appeared. On December 6 the last winged form appeared in the laboratory. The winged forms do not produce any woolly secretion. Not every colony in the laboratory produced winged forms. Several colonies were observed where nearly all of the forms produced wings and after the death of the old apterous forms only a few wingless young remained to perpetuate the colony. In some colonies, on the other hand, only a few winged forms were produced.

The offspring of these winged forms are the true sex forms. A number of these winged Aphis were isolated, each one being placed in a separate tube. It was found that they begin to reproduce on the sixth day. This gives the date for the appearance in the laboratory of the first sex forms as September 25. Many of them died without producing any young. Out of a series of nineteen only eleven reproduced, as is shown by the table on page 169.

These true sex forms differ from the agamic forms in that they produce no woolly secretion and have no beak. This latter difference is apparent from the very first, because the young of the common forms have a beak longer than their body. Since these true sex forms have no mouth-parts they cannot take any food, yet they pass through four molts, which seems to require about eighteen days. The male increases very little in size, and increase in the female is probably due mainly to the development of the egg. It may be added here that both sexes remain wingless throughout life.

The sex forms differ among themselves in size and color. From the very first the male is smaller than the female, and in the adult form is not much more than one third the size of the latter. The male is throughout life of an olive green color, while the female retains the light chocolate brown.

Both sexes are quite active in the early part of their life, but apparently they seek only a favorable hiding place, where they can remain

quite inactive. After passing through the last molt, the male becomes quite lively and runs about in search of females, which do not move about in the latter part of their life, but are fertilized and lay their egg at the place where they spend the greater part of their life.

DATA FROM ISOLATED APHIDS

	Number of young produced	Males	Females
1	0	..	..
2	1	1	..
3	4	3	1
4	4	3	1
5	1	1	..
6	2	1	1
7	0	..	..
8	4	2	2
9	1	1	..
10	0	..	..
11	0	..	..
12	3	3	..
13	0	..	..
14	0	..	..
15	3	2	1
16	1	1	..
17	3	3	..
18	0	..	..
19	0	..	..
Totals	27	21	6

Two true sex forms, male and female, which were produced on November 26, had molted for the fourth time on December 8, probably before that time. They were confined to close quarters in a test tube, and after a few hours were seen to mate. On the following day, December 9, the female deposited her egg. The egg is of brown color, and about twice as long as wide. After oviposition the female looked quite shriveled up, yet lived several hours. The mating of this pair had probably not been successful, since the egg retained its brown color.

As seen from the above table, I did not succeed in getting more than four young from a winged female. Other investigators say, however,

that each winged Aphis normally produces eight young, of which four are males and four females, but in their laboratories they succeeded in getting only three to six.

The cytological studies of von Baehr, Volume III, 1909, in the "Archiv für Zellforschung" under the title of "Die Oogenese bei einigen viviparen Aphididen und die Spermatogenese von Aphis saliceti, mit besonderer Berücksichtigung der Chromatinverhaeltnisse," contain valuable facts on the development of true sex forms in *Schizoneura lanigera*. The more important points of that part of his paper bearing on our problem are here given.

Von Baehr removed the embryos from very young nymphs. The nymphs were just showing the wing pads, and the embryos removed from them were, therefore, of the kind regularly developing into true sex forms. Sections of the ovaries of these embryos of true females were compared with sections of ovaries taken from agamic embryos in the same stage of development. At this stage the ovaries of the two forms were exactly alike.

In embryos taken from somewhat older nymphs he found that most of the ovarian tubes contained parthenogenetic eggs, while two of them develop into winter ovaries. Of these two, only one is fully developed, the other ovary with its egg is spoiled before maturity. This explains the process by which only one egg is produced by the true female, whereas all the other forms give birth to more than one young.

MR. SYMONS: I would like to ask Mr. Hunter what was the per cent of Aphids at the beginning of the season?

MR. HUNTER: About 90 per cent. We cleared a total of 70 per cent clean trees, about 20 per cent with knotty rootlets and about 10 per cent that had Woolly Aphis present on them after the season's treatment.

MR. SYMONS: You had different blocks?

MR. HUNTER: Of two-year stock.

MR. SYMONS: I tried tobacco dust and lime-sulfur on some two-year-old trees and got the best results with tobacco dust. It was put on very carefully.

PRESIDENT SANDERSON: The next paper will be presented by Mr. A. G. Ruggles.

Apparatus for study of woolly aphis and other subterranean forms: Iron table, 3 x 12 x 1. Iron doors drop, revealing root growths and insects thereon through the glass. That is the earth is held in position by plate glass and kept darkened unless when opened for observation by ten 1 x 3 feet iron doors. (Original.)

THE LARCH SAWFLY IN MINNESOTA

By A. G. Ruggles

The northern part of Minnesota has an enormous acreage in timber, and will have for a number of years to come, in spite of the forest fires and normal cutting processes. It has been impossible to determine the amount of tamarack in this region, although a number of foresters familiar with the tamarack areas have been questioned. An estimate given ran up into the millions of dollars.

When the Larch Sawfly began its depredations in 1908 there was great concern among the lumbermen. The presence of this insect was first noted in August, 1909, though from the dead and dying tamaracks seen the pest must have been at work during the two or three preceding years. At the present time there are, to my knowledge, three areas of infestation in Minnesota,—one at Itasca Park (a thirty-five-square mile tract around Lake Itasca, the source of the Mississippi), one at Cloquet, where the State Forestry Experiment Station is located, and another near Ely in the United States Government reserve. Unfortunately the writer has examined personally only the area at Itasca Park, and there not in the breeding season, but each of two years just as the larvæ were leaving, or had, for the most part, left the trees.

The work on the insect has been done almost entirely in the insectary. Several hundred cocoons were gathered in the spring of 1910, but from this number only 125 adults were reared, and of these it is interesting to note that three were males, a larger percentage than Doctor Hewitt found in his work on the Larch Sawfly in Europe, although perhaps with a larger number reared a smaller proportion of males might have appeared.

One species of Hymenopterous parasite was reared, which occurred in large numbers. I estimated that 10 to 15 per cent of the cocoons showed the presence of this parasite. Mr. C. T. Brues identified it as *Diglochis* sp.

Prof. R. H. Pettit, of East Lansing, Mich., learning that work was being done on this sawfly, kindly sent me a fungous preparation to scatter among the larvæ as they were descending the trees to enter the soil. Unfortunately, this fungus arrived after the cocoons were well formed, but in spite of this a few experiments were started, and by September 1 the fungus had spread considerably. This fungus, however, seems to be almost identical with the one found by me this summer under natural conditions. In one small area I found as many as 5 per cent of the 1909 cocoons infected.

The season of 1910 in Minnesota was the driest in the history of the white man. In Itasca Park where, in former years, the mosquitoes had been unbearable, in 1910 no mosquitoes were present, even in the usual swampy regions of the park. I give this to show how dry it was. Now, whether because of this excessive dryness or not, the Larch Sawfly larvæ did not remain on the tamaracks as long as they had in previous years, leaving while the trees still showed green. Also, the cocoons were considerably smaller than they had been in previous years. It seems, then, that the tamaracks here will have a little respite next year from the gross attacks of these pests. The other regions of infestation, according to reports received, did not manifest any such peculiarity.

PRESIDENT SANDERSON: Any discussion?

MR. HUNTER: Doctor Hewett sent us from England 340 pupæ of the Larch Sawfly, and we placed them in the ground. Some thirty of them emerged as females, and the rest either did not emerge, or were parasitized, and we got no males at all. We attached them to larch cuttings, kept them green, but were unfortunate in getting no oviposition.

Adjourned.

Afternoon Session, Thursday, December 29, 1910

The session was called to order at 1.30 p. m. and after the transaction of business the reading of papers was continued.

PRESIDENT SANDERSON: The first paper will be presented by Mr. Swenk,

A NEW SAWFLY ENEMY OF THE BULL PINE IN NEBRASKA

By MYRON H. SWENK, *Lincoln, Neb.*

[Withdrawn for publication elsewhere.]

PRESIDENT SANDERSON: Is there any discussion on this paper?

SECRETARY BURGESS: I would like to ask Mr Swenk in regard to the bacterial disease, if he finds it present where there is only a small number of caterpillars, or whether it is present only during severe outbreaks.

MR. SWENK: I think you will find some disease when caterpillars occur in small numbers but it is more common when many are present.

President Sanderson: The next paper will be given by Mr. O'Kane.

CONTROL OF THE APPLE MAGGOT BY PICKING UP DROPS

By W. C. O'Kane, *New Hampshire*

The Apple Maggot, *Rhagoletis pomonella* Walsh, continues to be one of the troublesome fruit pests in the New England States and in eastern Canada. Of the apple enemies in this region it is probably the most serious, and unquestionably the most difficult for the grower to handle.

For the past year and a half the New Hampshire station has been at work on this insect. The investigation is still in progress. But some interesting facts have come to light this season.

Among these are the results of a series of experiments in the matter of control by picking up drops. Since these particular results have a definite economic bearing, they seem worth presenting in brief summarized form at this time in advance of detailed publication at a later date.

Ever since it was found out that the maggot matures in the drops, and goes from them into the ground to pass the winter, the usual advice to the grower has been to keep the drops picked up. This has been, and still appears to be, the most vulnerable point in the life round of this insect.

But what do we mean by keeping the drops cleaned up? How often must the fallen fruit be gathered? Offer this remedy to a dozen fruit growers, and they will give it half-a-dozen different interpretations. In conversation with, and reports from, many growers, I have found that some of them considered that they were keeping the drops picked up if they cleaned up the orchard once or twice in a season; others rejected the remedy because they inferred that the scheme involved a cleaning up once or twice a day.

It has not been possible to offer the grower specific instructions, for there are no records on which to base a definite program.

It is quite conceivable that in a given case a remedy which required going over the orchard daily would be impracticable and uneconomic, while a clean up once a week, for example, if this would suffice, would easily be managed.

Our plans for the past season, therefore, in our work on the maggot, included a rather comprehensive series of experiments designed to determine definitely how often the drops must be picked up; or, in other words, how soon after the apple falls the maggots leave it to enter the ground.

At the outset it seemed reasonable to suspect:

First, that the period after the apple falls and before the maggots begin to leave it would vary with different varieties of apples.

Second, that the period would vary according to the comparative maturity of a given kind of fruit.

Third, that it would vary as the general season advanced.

With these possibilities in view the experiments were laid out as follows:

Infested trees were selected representing ten varieties of apples, ranging from early or summer fruit to winter varieties.

All the drops under all of these trees were gathered daily and were then so disposed as to afford the following information for each of the ten varieties:

First, the number of drops gathered each day.

Second, for each successive week throughout the season, the total number of larvæ issuing within the first twenty-four hours from the time the apple falls.

Third, the same for the second twenty-four hours, the third twenty-four hours, and so on up to the eighth day.

Fourth, throughout the season selected lots of apples were kept under observation until they rotted, and data recorded showing the number of larvæ issuing the second week after the apple falls, the third week, and so on.

The ten varieties considered in the experiments were as follows:

1. Early Harvest, season, late July and early August.
2. Red Astrachan, season, late July to September.
3. August Sweet, season, August and early September.
4. Sops-of-Wine, season, August to early October.
5. Porter, season, September to November.
6. Russet Sweet, season, September to November.
7. Jersey Sweet, season, September to November.
8. Gravenstein, season, late September to November.
9. Westfield, season, October to winter.
10. Winter Sweet, season, October to winter.

The number of drops observed averaged about two thousand for each variety. The total number was 20,230. In considering certain results the Russet Sweet is omitted because the trees of this variety proved to be rather sparingly infested.

Summaries only of typical varieties will be given here.

The August Sweet is a good example of an early or summer apple quite generally infested. In this apple, at the beginning of the season, a few maggots emerged from drops within the first seven days, a very small number within the first and second twenty-four hours.

The ratio, however, is only thirty-eight maggots emerging the first week per thousand drops.

As the season progresses the number emerging the first seven days steadily rises, until it reaches a maximum of 730 per thousand drops at the end of this variety's season. In general, throughout the season, there is a slight but steady increase from the first to the seventh twenty-four hours of each week.

Taking up now the performance for the second and succeeding weeks that the drops were off the trees: In the early part of the season we find that the number of larvæ emerging after the first seven days rapidly rises to a maximum the third week after the apple falls, and then quickly diminishes to a comparatively small number the fifth and final week.

This rule holds good for every lot through the season of this variety, but as we get farther along the apples rot very soon after they drop, so that the third week off the tree finds them completely decayed, and consequently no more larvæ issuing.

Summing up the entire season records for this variety, and taking an average of all the drops observed, we find that for the first twenty-four hours after the apple falls, eighteen larvæ emerge per thousand drops; for the second twenty-four hours, seventeen larvæ emerge; for the third, twenty-two larvæ; for the fourth, twenty-five; for the fifth, eighteen; for the sixth, thirty-one; and for the seventh, forty-three. Thus we have for the first seven days after the apple falls a total of 174 larvæ emerging per 1,000 drops.

Again, taking an average of all the lots observed, we have for the second week after the apple drops a ratio of 988 larvæ per thousand drops; for the third week a ratio of 4,515 per thousand drops; for the fourth week, 1,299; and for the fifth week, 22.

For the whole season in this variety the total number of larvæ issuing per thousand drops was 6,898.

Considering now one of the earliest of the fall apples, the Sops-of-Wine, we find parallel results, but with the exception that the first seven days after the apple falls show proportionately a smaller number of maggots emerging, the season average being fifty-nine larvæ per thousand drops. In the second week this ratio becomes 710 per thousand; in the third week, 2,189 per thousand; in the fourth week, 1,473; and in the fifth week, 120.

The Porter gives a similar performance. Here the season average shows 12 larvæ emerging per thousand drops the first week after the apple falls; 242 the second week; 579 the third; 392 the fourth; and 67 the fifth.

Ranking as a little later fruit than the Sops-of-Wine, but still in the

class of fall fruit, the Jersey Sweet exhibits results that fall in line with the others. Comparatively few larvæ emerge in any one of the first seven days, the average number per thousand drops being 4 for the first 24 hours; 2 for the second; 2 for the third; 5 for the fourth; 6 for the fifth; 8 for the sixth; and 12 for the seventh. Thus there is a considerable increase toward the end of the seven days, but the total for the first week, taking an average of all the apples observed, is 39 larvæ per thousand drops. This number rises to a maximum of 2,555 larvæ per thousand drops in the fourth week after the fruit falls, and then diminishes to 8 per thousand the eighth week.

In the Winter Sweet we have an apple that belongs in the class of genuine winter fruit. In this variety practically no maggots appear until the apple has been off the tree for five weeks. The ratio is only 2 larvæ per thousand drops the first week; 1 the second; 7 the third; 5 the fourth; and 5 the fifth. For the sixth week the number increases to 33; for the seventh 46; for the eighth 78, which is the maximum; for the ninth 74; for the tenth 19; and for the eleventh 11.

At this point, an examination of the records gives definite answer to three questions connected with control of the apple maggot by picking up drops; as follows:

First, the summer or early fall fruit is of such character that a much larger percentage of maggots finds it possible to mature in it than in late varieties. From other records on hand it might be shown that the August Sweet and the Winter Sweet handled in these experiments did not differ widely in the average number of egg punctures per apple, Nevertheless the former, an early variety, gave for the season an average of 6,898 maggots emerging per thousand drops, while the latter, a winter variety, gave a ratio of only 281 maggots per thousand drops. In other words, the early fruit needs particularly to be watched by the grower.

Second, whatever the variety, the drops that first fall will mature the most maggots. If we examine representative lots in each variety and compare the total number of larvæ emerging from apples that dropped early as compared with those that dropped late, we find that there is a steady decrease as the season advances. This means, of course, that whatever the kind of fruit, the grower must not neglect the early drops.

Third, there is little need to pick up drops after the middle of October in the latitude of southern New Hampshire. Early varieties have passed out of existence by this date, and late drops, though badly infested, do not mature many larvæ.

This leaves for consideration the main question: How often must the drops be gathered?

A survey of the records indicates that to answer this question it is advisable and practicable to group the apples into three classes: early or summer varieties; fall varieties; and late fall or winter

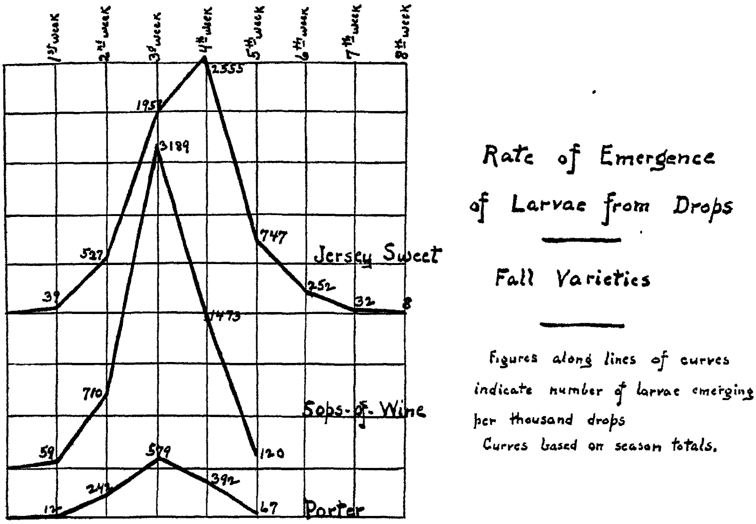


Fig. 1

varieties. The question is easier if we chart the average performance of the varieties observed.

So doing, we find that the August Sweet, Early Harvest and Red

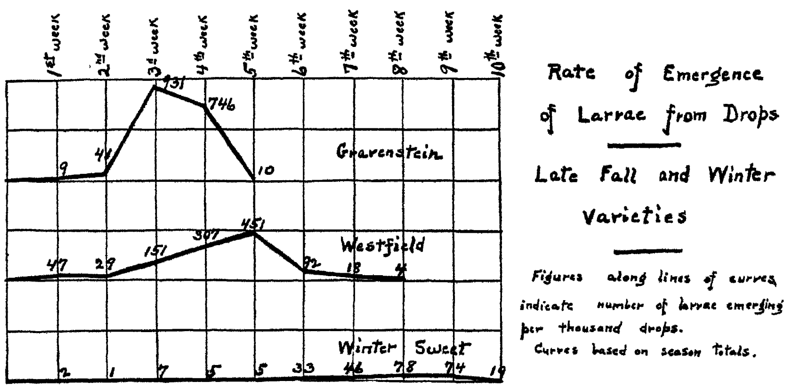


Fig. 2

Astrachan, typical of summer fruit, describe a curve that rises fairly rapidly the first week. The Early Harvest shows the sharpest rise, and is also the earliest fruit. The Red Astrachan shows the least angle of rise, but, in proportion to the total, this angle is considerable. Evidently the first week is productive of trouble in this class of fruit.

The Jersey Sweet, Sops-of-Wine and Porter, typical of fall fruit, exhibit a slight rise the first week, and a much greater one the second. Here, evidently, we may safely make our interval longer.

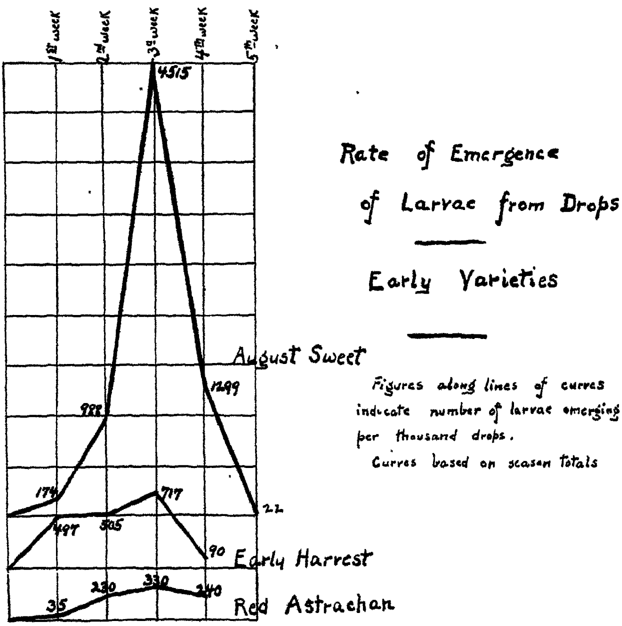


Fig. 3

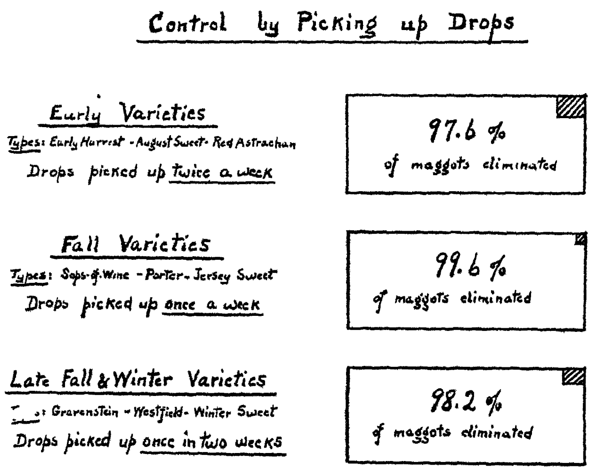


Fig. 4

The Gravenstein, Westfield and Winter Sweet show varying curves, depending on the lateness of maturity of the variety, but they have in common a slow rise for the first two weeks.

Bearing in mind that any plan of control proposed must be practicable and economical for the grower, the following program is offered:

With early or summer fruit the drops should be picked up twice a week. With the typical varieties handled this last summer, this frequency will eliminate 97.6 per cent of the maggots that would otherwise have matured and entered the ground.

With fall varieties the interval may be made once a week, giving results of 99.6 per cent of the maggots eliminated.

With late fall and winter varieties the drops should be picked up once in two weeks, giving results of 98.2 per cent of the maggots eliminated.

PRESIDENT SANDERSON: The next paper will be presented by Professor Osborn.

SOME NOTES ON INJURIOUS LEAF HOPPERS

By HERBERT OSBORN, *Columbus, Ohio*

[Withdrawn for publication elsewhere.]

PRESIDENT SANDERSON: Discussion of this paper? The next paper will be given by Mr. R. L. Webster of Ames, Ia.

NOTES ON THE WHEAT-HEAD ARMY-WORM (MELIANA ALBILINEA HÜBNER) AS A TIMOTHY PEST

By R. L. WEBSTER

Recent injury. During the past year much damage to timothy has been caused by the wheat-head army-worm in Iowa. The most serious damage was in the northern half of the state, although the insect was fairly common elsewhere. This outbreak extended into Minnesota and eastern South Dakota, so I have been informed.

Appearance of the injury. The larvæ gnaw into the heads of timothy, wheat, rye, other small grains, and some of the wild grasses, but they prefer timothy to anything else. The damage is mainly to the timothy seed crop, since the larvæ eat the seeds. Where the injury is severe the hay crop may be considerably affected. The larvæ begin to feed at the bottom of the head and work upward, sometimes eating only one side, sometimes taking all but the stem, allowing the chaff to fall to the ground.

Life History

There are two generations in Iowa. The first brood of larvæ feeds mainly on timothy heads, while the second feeds largely on a number of wild grasses, taking the second growth of timothy whenever the larvæ can find it.

The insect winters in the pupa stage in the soil. The moths emerge in May. This spring I found eggs on the base of timothy plants, tucked under dried leaves there. Previously eggs had been found only in the sheath of some of the food plants in the summer. None were found in that position in the spring. The young larvæ appear about May 20 and begin to feed on leaves of timothy plants. They were found only on timothy early in the year. When the timothy heads appear the larvæ go to them.

The injury to timothy becomes conspicuous about haying time, when the larvæ are about mature. The larvæ go to the ground in July, pupate, and the moths emerge early in August. We began to look for eggs on the base of timothy plants in August, where we had found them in the spring. Not until we began to examine the sheath of the plants did we find eggs. The eggs were deposited in single, double or even triple rows, as Riley observed.

Eggs hatched in the insectary in three to ten days. The larvæ began to appear outside about the middle of August, and were found as late as October 15. When mature the larvæ go into the soil, spending the winter as pupæ.

Food Plants

Previously this insect had been recorded from most of the small grains, as the following list indicates: Wheat, timothy, barley (Lintner), rye, oats (Riley), sweet corn, sorghum (Miss Murtfeldt), wild rice (Chittenden), Indian corn (Forbes). The grass-feeding habits of the larvæ had been noticed by Riley, Osborn and Smith, but I have found no records of any particular grasses as food plants. In the Iowa work the following grasses were found to be eaten, either the heads or the leaves being affected, or both. They were: blue stem (*Andropogon furcatus*), Indian grass (*Sorghastrum nutans*), barnyard grass (*Echinochloa crusgalli*), green foxtail (*Setaria viridis*), yellow foxtail (*Setaria glauca*), red top (*Calamagrostis canadensis*), awned wheat grass (*Agropyron caninum*), *Agropyron* sp., and squirrel tail grass (*Hordeum jubatum*). Eggs have been found in the sheath of speltz and *Elymus robustus* (robust lyme grass). These also are probably food plants.

Distribution

Although the species was first noticed by European writers, it is not known to occur outside of America. To the north the moth has been taken from Nova Scotia to Alberta, to the east in Delaware and New Jersey, to the west at Glenwood Springs, Col. (Barnes), and southern Arizona (Barnes). According to Sir George F. Hampson the species occurs at Mexico City, Mexico; Coquimbo and Mulchen, Chili; and Florenzia, Argentine. Buenos Ayres, Argentine, was given as the source of Hübner's type.

Natural Enemies

Dipterous parasites. Three tachinids were reared from the larvæ. Two of these, *Winthemia quadripustulata* Fabr., and *Euphorocera claripennis* Macq., are common species, and have been reared from many other hosts. The first species was by far the more numerous. It was very abundant in the summer of 1910, but was not found at all that fall. The third species, *Metachæta helymus* Walker, was more rare. It was reared in the fall only. The determinations are by Mr. D. W. Coquillett.

Besides these three Riley recorded another tachinid as parasitic on the wheat-head army-worm. This is *Frontina frenchii* Will.

Hymenopterous parasites. In the summer of 1910 an egg parasite was found, which has never been recorded. Mr. A. A. Girault tells me that this is a new species, and he has given it the manuscript name of *Pentarthron retorridus.* It was first seen August 23 by the writer, when a single specimen was observed ovipositing in eggs of the wheat-head army-worm. Afterwards it was reared abundantly, emerging August 30 to September 14.

The hymenopterous parasites of the larvæ were less numerous than the tachinid parasites. Of these, *Microgaster auripes* Prov. (H. L. Viereck determination) was the most common.

Another parasite, somewhat less common, was a species of Microplitis, which Mr. Viereck says is new. This parasite affected the younger stages of the larvæ only. A secondary parasite was reared from one of the Microplitis cocoons, a new species of Mesochorus, according to Mr. Viereck.

One specimen of *Paniscus geminatus* Say (Rohwer determination) was reared in 1910.

My father, F. M. Webster, writes me that *Apanteles læviceps* has been reared from this host in New Mexico by Mr. C. N. Ainslie.

Riley had previously recorded two species from this host, which

were not reared by us. These were *Anomalon apicale* Cresson and *Ichneumon brevipennis* Cresson.

Control Measures

Clean culture. Since the larvæ, especially those of the second generation, feed largely on some of the wild grasses, the presence of those grasses in meadows and along roadsides is a direct aid to the pest. A whole field might be stocked with these insects from those which breed along the roadsides, both on the volunteer timothy and on the grasses. The farmer should look to the roadsides and fence rows, as well as the fields, and try to keep these grasses down as much as possible. Clean culture is one very essential factor in the artificial control of this pest.

Fall plowing. During the first two weeks of September, larvæ are at work on young timothy plants in meadows, as well as on foxtail and other grasses. Sod that is turned under at this time would effectively bury and kill the young larvæ. Any that might escape would find nothing to eat.

If it is impracticable to turn under a meadow in the fall, or if it is to be kept for another year in sod, a measure such as early fall pasturing would be advisable.

Early fall pasturing. In the summer of 1909 it was found that pastured meadows were often less injured than those which were not pastured. Since the young larvæ of the second generation are at work in meadows from the middle of August on, it is easy to see that rather close pasturing early in the fall would keep the grass down so well that the larvæ would be starved out. Doubtless many timothy stems containing eggs would be eaten, eggs and all, and probably some of the young larvæ would share the same fate.

Late spring pasturing would have the same effect, but the eggs and young larvæ do not appear until late in May, too late for pasturing, if hay is to be cut from the field.

A large number of counts were made in pastured and unpastured meadows, which showed the benefit obtained by fall pasturing. In the counts usually 500 or more timothy heads were taken at random, keeping track of the number that showed injury by the wheat-head army-worm.

A few examples of these counts follow: In a two-year-old, unpastured meadow near Woodburn, Iowa, 20 per cent of the timothy heads were injured. Another nearby meadow, also unpastured, showed 20.6 per cent injury. A third unpastured meadow was infested to the extent of 21.1 per cent. In a meadow eight or ten years old, which

had been pastured in the spring and fall of every year, 6.1 per cent of the heads were injured, in a count of 1,500 heads. Another meadow, pastured only in the fall, showed 3.6 per cent injured heads.

In a one-year-old clover and timothy field at Dexter, Iowa, 28.6 per cent injured timothy heads were found in 1909. That fall the field was heavily pastured, and the larger part of it was plowed in the spring and put into corn. On July 1, 1910, only 10.2 per cent of the timothy heads were injured in the part of the meadow that remained. But the greater part of the field had been turned under that spring. The moths that emerged in the spring, then, would deposit their eggs in the timothy that remained. Had the field been left unplowed, the average injury in 1910 would doubtless have been much less than 10.2 per cent.

Two meadows near Ames, one pastured and the other unpastured, were compared in the fall of 1910. Both were badly infested that summer. Stock were put in the one field between September 6 and 10, and they ate the grass down fairly close within ten days or two weeks. October 4 this field was compared with the unpastured field, and an amazing contrast was found between the two. No larvæ were found in the pastured field, but they were quite common on the second growth of timothy in the other field. This second growth had been kept well eaten down in the pastured field. Later observations showed the same result, no larvæ in the one field and injured timothy heads and plenty of larvæ in the other.

If a meadow is to be pastured, stock should eat down the infested fields fairly close during the first half of September, certainly before the 15th. Where timothy and clover are grown together, care must be taken that the pasturing is not so close that the clover is exposed to injury during the winter. A field might be pastured fairly close before the middle of September, and left free of stock the rest of the fall, giving the clover some chance for growth after that time

To summarize, fall pasturing is the best measure that we know of against the wheat-head army-worm in timothy; early fall plowing and clean culture are measures next in importance.

President Sanderson: Discussion of this paper?

Mr. Smith: I should like to ask Mr. Webster how many adults he bred.

Mr. Webster: Thirty or forty.

Mr. Smith: The reason I ask this question is that in our experiments we have found out that only a very few could be actually raised, and so got very little information as to species, and as a matter of

fact we could not tell whether we had two or three species to deal with. It is quite likely that there are three different species. One authority says that the species he has dealt with is the same all over the country. Now, if Professor Webster has those specimens still, I should like the privilege of examining them, and see which of the particular forms he has found and bred. Of course, it is likely that all those are of one species, but it will help us to get some information.

Mr. Washburn: An army worm in Minnesota this year was extremely destructive to timothy in the southern part of the state. I believe at least two thirds of the timothy seed in Minnesota was destroyed.

President Sanderson: I think this finishes the papers to the symposium on spraying machinery. Professor Ball is not here, but has sent his paper, which will be read by the secretary.

SPRAYING APPARATUS FOR ORCHARD INSECTS

By E. D. Ball, *Logan, Utah*

While it is possible to do thorough orchard spraying with nearly all makes of spraying apparatus on the market at the present time, still there are many things to be desired before the highest efficiency will be reached.

There is a movement on foot at the present time to standardize the requirements of the different spraying outfits and to make tests of their comparative efficiency. This is a good movement and one which the entomologist should encourage in every way possible, and now is a very opportune time for us to discuss the problems connected with spraying apparatus in general and point out the lines in which improvement should be made in order to increase efficiency. No doubt many improvements and changes will be made as the result of these tests from time to time and if the lines along which improvements are needed are pointed out, it may assist the manufacturers to more rapidly reach the desired ends.

The construction of pumps was long ago reduced to a science and there is little room for improvement along general lines of pump construction. The adaptation, however, of some of these principles to uses in connection with high pressures and different spray mixtures needs further consideration. The present line of barrel pumps scarcely come within the class of orchard sprayers. A few of the larger ones with large air chambers and arrangements whereby the packing of the plunger may be tightened at any time are capable of developing and maintaining sufficient pressure to be efficient

within the limits of their capacity. The double-acting hand-power pumps are usually efficient instruments, provided the air chamber is of sufficient size. Many of the present models are equipped with air chambers too small to equalize pressures above 200 pounds. In the power outfits much loss has been occasioned through lack of rigidity in the construction of the frames, which often yield under trying conditions to which they are subjected in orchard work. Many of these outfits are put out with too small air chambers for the pressure that they are capable of developing. Provision should be made in all outfits expecting to handle pressures above 100 pounds whereby air can be forced into the chamber under pressure before pumping of liquids is commenced, thus giving a much larger air cushion than can be obtained where liquid is forced into the air chamber and only a small amount of air is compressed. This problem has been solved by different manufacturers in different ways and should be a requirement of all outfits in the future.

One of the most annoying features of present pump construction is the liability of trouble with the relief valve. The constant friction of spraying solutions passing through the valves soon wear the delicate parts until it is impossible to make adjustments and still allow of sufficient escape to handle all the liquid when the nozzles are shut off. Unless there is sufficient room to handle the entire capacity of the pump with ease, the pressure runs up when the nozzles are turned off and the pump is thereby subjected to severe and useless strain which only results in more rapid wearing of the affected parts. Many devices have been designed to overcome this objection and some of them are fairly successful. A device on exhibition at the recent tests at Council Bluffs, in which the entire matter was obviated by regulating the amount of liquid taken in through the suction pipe and doing away with the escape valve, suggests the possibility of entirely obviating these defects in the future. While probably improvements could be made on the present apparatus, the principle of shutting off the liquid when the nozzles are cut off rather than providing for an escape is the correct one, thus obviating almost all unnecessary wear on the engine and pump. In this connection, it has already been suggested by different workers that the outfits of the future will probably not pass the spraying liquid through the pump at all. One of the most serious drawbacks to efficiency of spraying apparatus at the present time is the necessity of fitting them to resist the corrosion of the different spraying compounds. If the necessity of passing these through the pump is obviated, it will probably both cheapen and simplify pump construction. The prime requisites of successful orchard work are unlimited power and constant pressure, and, on this account, spray-

ing outfits depending upon traction for their motive power will find little place in Western orchard work.

The equipment of the orchard outfit is, if anything, more important than the pump itself and must vary greatly to meet the needs of the different lines of work. For Western orchard work, every outfit should be equipped to meet the requirements of the codling moth spray and then with slight modifications it can be adapted to the other lines of work in which it will be used. This equipment should consist of twenty-five to thirty feet of ½-inch seven-ply hose with small inconspicuous couplings capable of withstanding pressures up to 250 to 300 pounds. These couplings should be capable of being tightened on to the hose by heavy screw threads. On the end of the hose should be placed a light bamboo pole eight to twelve feet long. The shorter lengths are best equipped with brass inside rods, while aluminum is probably better for the twelve-foot poles on account of its lightness. In any case, the couplings connecting the rod and pole should extend down over the bamboo for a considerable distance and be capable of tightening as the wood shrinks, so that there is no possibility of the rod turning inside of its wooden cover. Such a connection as this also prevents the danger of breaking the threads of the rod through the excessive weight of the heavy hose. At the bottom of the bamboo pole there should be a cut-off which works instantaneously with a single motion of the hand and in which the lever projects as little as possible. In fact, it is very important to have the entire coupling of hose and pole as neat and compact as possible, so that it can be readily passed through the hand without catching in the ordinary spraying manipulations. The end of the pole should be equipped with a small compact angle to which the spray nozzle can be attached. Some nozzles are now fitted with their own angle and in certain cases this may be preferable. On the other hand, a separable angle admits of change for different kinds of work and different nozzles.

The nozzle is probably the most important part of the entire outfit, as without the proper nozzles many outfits costing from $200 to $300 have been rendered inefficient and thousands of dollars of loss entailed. There seems to be a very wide misunderstanding among the various manufacturers at the present time as to the exact requirements of an efficient nozzle, and, while we have many types and innumerable modifications, there does not seem to be a clear understanding of the object sought. Especially is this true of those of the driving spray type. The two major requirements of the driving spray are capacity and penetration and a third factor to be considered is economy of liquid. Only two persons can work to advantage on one spraying

outfit, and much more efficient work will be done with the driving spray where there is only one nozzle to each operator. Therefore, driving spray nozzles should have sufficient capacity, so that two of them will use nearly the minimum amount of liquid ordinarily delivered by a power sprayer. The best results with the driving spray are accomplished where fine drops are driven to a distance of five or six feet before breaking into a mist, and this can only be produced where the aperture is large enough to give considerable pressure to the liquid outside. The smaller the aperture the more quickly the spray will fog and the less penetration. If, on the other hand, too large an aperture is used, the drops will be too coarse for good work. Nozzles of the Deming "Bordeaux" and the Bean "Double" type seem to have approached fairly close to the limit of capacity and efficiency in this type of construction. Many of the other so-called Bordeaux nozzles have so small an aperture that only a small amount of liquid can be handled through them and this fogs very soon after leaving the nozzle. There are some advocates of the Vermorel type with a large enough aperture so as to give considerable penetration. In the writer's experience, this type of nozzle, although capable of doing fairly good driving work, is quite wasteful of liquid, as, in thorough spraying, practically all the liquid of the flat spray can be so directed as to be driven directly into the blossoms as they are arranged on a given branch, while with the cone-shaped spray, if one side is driving straight into the blossoms, two thirds of the circle will often be too far from any other branch to be effective, or sometimes lost in space. These larger Vermorel types such as the "Friend" and "Mystry" are, however, much to be preferred for cover or mist spraying to the batteries of smaller sized nozzles formerly used. There is a great deal of room for improvement, however, in the distributing power of these different types of sprays. There is scarcely one of the flat spray type but what delivers the liquid with very unequal pressures in the different parts of the spray, while the cone-shaped type could probably be improved if it could be made a solid cone of equally distributed spray rather than a hollow one. A great amount of useless expenditure is occasioned by making nozzles with soft-wearing surfaces. The nozzle of the future will undoubtedly have hardened wearing surfaces that are easily and cheaply renewed.

The tower is becoming more and more important in Western spraying—in fact, a very large percentage of the Western spraying of lime and sulphur is now done from some form of platform or tower. Any apparatus which places the operator on a level with his work tends greatly towards rapidity and efficiency of performance. The disadvantages of the old-fashioned square-posted tower with a railing

around it are numerous. The width makes it difficult to get through the orchard without injuring the trees and the railing is constantly in the way of the operator in handling the back end of his pole. The tower of the future will probably be constructed with a narrower base and coming to an apex much like the present windmill tower, on top of which will be placed a small round platform with a footrail and in the center a single iron post with a revolving seat similar to a miniature saddle or a racing bicycle seat. With this type of seat, the operator can cling to the seat by clasping it with his legs and with his feet on the small round platform, will be free to move around and at the same time have perfect freedom in handling his pole and hose. Where two operators are spraying from one machine, such a platform can be constructed at each end of the outfit. These small steel towers if sufficiently braced could be made removable by removing four bolts or so that they would fold down on removing two, which would enable the outfit to quickly pass through otherwise inaccessible places.

As a final word, the writer would suggest that the greatest difficulty met with in practical work to-day is the fact that so few of the manufacturers place their machines in the field fully equipped for the work which they are required to do. The writer has time and again been called on to assist in starting an outfit, only to find that it lacked a number of small, but necessary parts, such as cut-offs, angles, satisfactory hose-couplings and, in many cases, efficient nozzles.

President Sanderson: The next paper will be read by Mr. Worthley.

SPRAYING OF WOODLAND AND SHADE TREES

By L. H. Worthley, *Boston, Mass.*

The subject which has been assigned to me is one of great economic importance in its relation to the suppression of leaf-eating insects. In all the world's history, I believe there is no parallel to the heroic fight being made by the state of Massachusetts in her efforts to protect the forests and shade trees within her borders from the deadly ravages of the gypsy and brown-tail moths. Thousands of men have been employed, and millions of dollars expended already, and the battle is still raging.

Of the various methods employed since the early nineties, in my opinion, none has proven more effective than spraying with arsenical poisons. While spraying operations have been carried on in Mas-

sachusetts since 1892, it is only within a comparatively brief time that it has been on an extensive scale, so much so that it has been necessary to improve our spraying apparatus, so that a large amount of work could be done in a short space of time. In this year's work, approximately 500 tons of arsenate of lead were used in the suppression of the gypsy and brown-tail moths in Massachusetts, which necessitated the use of 200 power sprayers and 275 hand outfits. When spraying was first carried on in this work, the only apparatus which we had were hand pumps, ½-inch hose, Bordeaux or Vermorel nozzles, furnishing only mist spray. These pumps were mounted on barrels, which were in some cases mounted on wheels, and oftentimes it was necessary to put them in express wagons. These were considered at that time very satisfactory, and this size of apparatus was used in the work until 1900. Although considerable experimental work was carried on by the State Board of Agriculture at that time, few improvements were made.

The work against the moths by the state was stopped in 1900 and the insects allowed to go unmolested until May, 1905. Necessarily, the problem grew much larger, and the infestation in some localities was very severe. When the work was resumed under the direction of the Commonwealth, it was necessary to have improved apparatus. Owing to the fact that power sprayers had been introduced in 1895, and used by Mr. J. A. Pettigrew with the solid stream method, that is, spraying the trees from the ground, we considered that it was necessary for our department to have larger apparatus than had been previously used in the work. Several power sprayers were introduced by different manufacturers, their motive power being gasoline instead of steam as was used by Mr. Pettigrew. These machines did quite effective work, but they were not much of an improvement over the hand apparatus, as it was necessary to use the same small hose, Bordeaux and Vermorel nozzles, and climb the trees. They were not capable of maintaining pressure that would allow us to use a solid stream and give good results. The engines which were used on these sprayers were of the stationary type, and, owing to the fact that they had but one cylinder, so much vibration resulted that the apparatus depreciated rapidly. Duplex pumps were used also, and proved to be very unsatisfactory, as they did not give a steady pressure, even when small hose and mist nozzles were used.

Owing to these facts, it was necessary to induce the manufacturers to give us better and larger apparatus that would be more adapted to the work, and in 1907 and 1908 larger outfits were available. They were mounted on dead axle wagons, 400-gallon tanks, heavy triplex pumps, and mostly two-cylinder marine engines, although some of

them had two-cylinder stationary type. These machines gave much better results, as we were able to maintain higher pressures, and use the solid stream method in spraying woodlands, and, in many cases, shade trees.

As these machines were very heavy, they caused trouble in getting around in the woodland colonies, and placing them near pond holes where water was available; therefore, they did not give as good satisfaction as desired. These machines, however, could be filled by their own pressure from ponds, through a 2½-inch suction hose, and would deliver the solution at the rate of thirty-five gallons per minute, thus making an advance over the previous machines, but they did not do as well as expected, or give such results as were needed.

In 1909 and 1910, the State Forester's Department started experimental work along these lines. A power outfit was placed in the field last season, which proved more satisfactory than any previously used. It consisted of a platform spring running gear, 400-gallon "U"-shaped tank, triplex phosphor bronze pump, and four-cylinder marine type engine, capable of maintaining a steady pressure of 350 pounds. By using the four-cylinder engine much less vibration resulted, and the depreciation on the apparatus was greatly reduced. The pumps previously used were very heavy and bulky, and not calculated to maintain a pressure of over 250 pounds, so in building the new pumps, which were designed by the State Forester's Department, it was thought wise to use better material, and phosphor bronze was substituted.

The pumps are of cylindrical design, all flat surfaces being avoided, great strength and free passage of water being thus secured. The weight of these pumps, when completed, was about half that of those previously used. The agitators used in these outfits, up to the present time, have been propeller blades attached to an agitator shaft, running through the lower part of the "U"-shaped tank. These agitators were not entirely satisfactory, and for the coming season, we shall use more paddles, and feel that the settling of the lead in the bottom of the tank will then be very small. On these machines, the necessary pressure is determined by the length of hose which is being used in the work. One-inch marline-covered hose with full way coupling is used, and in lengths from 100 feet to 2,000 feet. This is determined by the size of the area which we wish to spray.

In order to spray woodlands and shade trees effectively, it is necessary to maintain 220 pounds pressure at the nozzle. We are spraying several thousand acres every year, and in one woodland colony, nearly 4,000 acres are being cared for, the average cost per

acre this year being $6.50. Ten pounds of arsenate of lead paste to 100 gallons of water was used at the beginning, and this amount gradually increased to fifteen pounds at the last of the season.

One other point must be considered in using power outfits. It is necessary to have the engine and pump work at all times when the solution is in the tank so that settling will not occur, for if poison is allowed to settle, it is very difficult to mix it perfectly again, and the poison will be unevenly distributed on the foliage. In woodland colonies after the thinning and creosoting methods have been applied, roads must be built, so that the apparatus can be used, and the colony sprayed with a reasonable length of hose. The building of the roads last year was done at a cost of 3 1-7 cents per square yard. We find it necessary to see that the poison is well mixed before weighing and placing it in the spray tank, because in numerous cases we have noticed that where large barrels of arsenate of lead have been allowed to stand for any length of time, the poison has settled to the bottoms of the barrels, thus making it very hard to mix properly when wanted for use. We are now experimenting with a mechanical device which can be attached to the outfit, worked by the power from the engine, to mix the poison thoroughly before it is taken from the barrel. If this is not properly done, the first half of the barrel will not have sufficient strength to give good results in killing the caterpillars.

The nozzle, which is used in our work, is another very essential point to be considered, as in previous years we have been obliged to climb the trees to a considerable extent, even when the solid stream was used. This was due to the fact that there was so much resistance in the nozzle that it would not give a stream of sufficient height, it being broken up and spread out immediately after leaving the tip of the nozzle. This year, we designed a nozzle, which has given excellent results. The first point which was considered was to eliminate as much of the resistance as possible, that is, having a full inch waterway direct to the tip. The shut-off and base of the nozzle, and the brass tubing running to the tip are each one inch internal diameter. At the top of this brass tubing is what is known as a "Hopkins," which stops the whirl of the water inside, and the tip is of an even diameter throughout, causing the stream to rise from twenty to twenty-five feet without breaking, as will be noted in the photograph. The proper length of the tips was a very hard matter to determine, and hundreds were made and tried out before the one giving the best results was selected, and by means of this straight water-way in the tip, we are able to spray ninety-five feet high. In our largest woodland problem this past year, we have experienced no trouble in spraying the greater part without climbing.

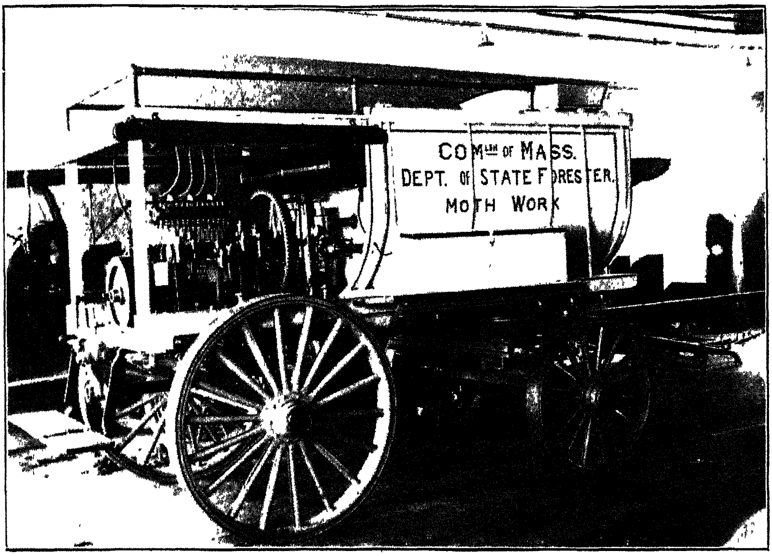
Through the efficiency of this nozzle, $2 per acre was saved in spraying a piece of woodland containing 3,018 acres. It is very essential that the operator of this nozzle shall use good judgment in directing the stream, so that the foliage will not be reached by it directly. He should hold it in such a position that the solution will reach the foliage as a mist, for if the force of the stream is applied directly to the foliage, the greater part of the poison will run off, and not sufficient remain to kill the caterpillars.

We have secured the best results in spraying woodlands the second year, when the undergrowth is allowed to grow up, and the poison which ordinarily falls on the forest cover is deposited on the undergrowth, within easy reach of the caterpillars. These machines are capable of filling through a 2½-inch suction hose in five minutes, or even less time, if pushed to their full capacity. In discharging, the average time is twelve to fourteen minutes, and nearly an acre is usually covered with one tank of poison.

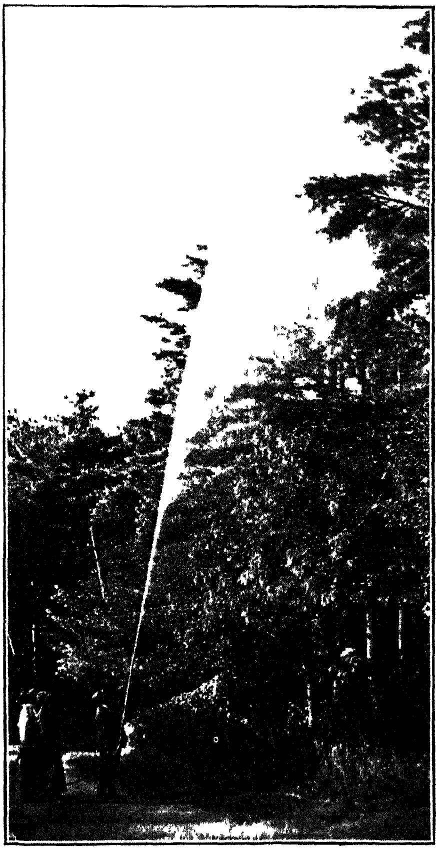
A good comparison between the machines previously used and the one designed by this department is that in filling with the old machines, it took from eighteen to twenty minutes, and discharging was done in from twenty-five to thirty minutes. The saving of time in this operation is a large item in the work, although it is necessary for the men to be much more active in their movements and there is but very little time to lie idle while the filling process is going on.

In what is known as the North Shore work, that is, the woodlands in Beverly, Manchester and Gloucester, where between 3,000 and 4,000 acres are being cared for, and where we have been fighting the moths systematically for three successive years, there will be from 1,000 to 1,500 acres the coming season that it will not be necessary to spray. These colonies will probably need to be sprayed alternate years.

The work on the shade trees in our state, where the trees on 14,000 miles of streets must be treated in suppressing the gypsy and brown-tail moths, is a very large problem in itself. Previously, the trees that were sprayed were climbed, and treated with a mist spray, taking much time and with great expense, but by means of the more modern apparatus used this last season, all of the street trees in several towns and cities were sprayed with the solid stream, which resulted in a large saving of money. It has been often argued that not as good work is done with the solid stream on shade trees as with the mist spray, but in looking over the results which have been secured, very little difference can be observed. It is our belief that the solid stream will give as good results as mist spray, except in a few cases where buildings may be temporarily defaced by the poison. Some of the machines are

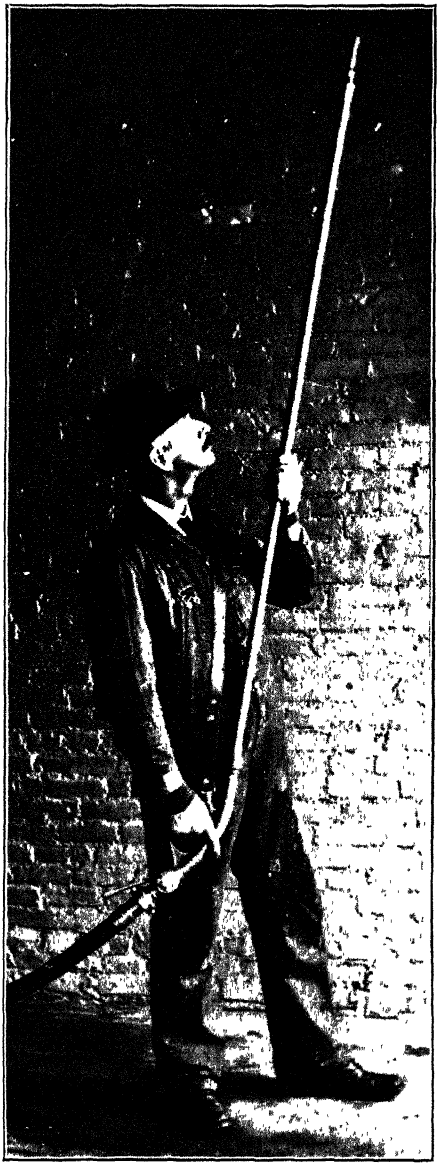


Gasoline power sprayer, built by State Forester's department, with four-cylinder engine and triplex pump, the latter designed by same department, capable of furnishing 300 pounds' pressure in woodland work. Weight of outfit, 3,000 pounds. (From Massachusetts State Forester's Report.)



OLD METHOD NEW METHOD

The above illustrations show nozzle and shut-off designed by State Forester's department for woodland work, with ¼ inch straight tip; also the nozzle formerly used, 18 inches long. Note difference in spray, as the long nozzle is carrying stream higher before breaking into mist. (From Massachusetts State Forester's Report.)



Long woodland nozzle with strap attached, shut-off and shoulder strap, designed by State Forester's department for high, solid, straight stream spraying. (From Massachusetts State Forester's Report.)

fitted with what is known as "extension towers" which consist of tubing from fifteen to twenty feet long, carrying a nozzle at the tip. This method has been used mostly by the United States Government in roadside spraying in the moth-infested area.

In some cases, it is not possible to secure as good results with the towers as it is with the long nozzle, and this is particularly true when the wind is contrary.

In calculating the cost of treating shade trees and woodland areas, a reasonable amount must be allowed for depreciation of apparatus. We consider that 20 per cent should be allowed annually on the machines, and 50 per cent on the hose. The average cost of spraying shade trees, both large and small, is between fifteen and twenty cents per tree.

One other improvement which I neglected to mention, which will be used in this year's machines is the high tension Bosch magnetos instead of batteries for ignition, and mechanical oilers in place of gravity feed. The use of the magnetos will strengthen the power and the oilers will eliminate excess oil in the engine base.

From our experience the different spraying outfits may be rated as follows: First, the hand pump, agitation not good, expensive to use when much work is to be done; second, small power outfits, not much better than hand sprayers; if the proper agitation is secured too much power is consumed and not enough remains to give efficient results at the nozzle. We find that efficiency and economy must be considered at the same time, and high class outfits, alone, will give these results.

President Sanderson: The next paper, by Mr. Worsham, who is not here, will be read by the secretary.

SPRAYING APPARATUS FOR SCALE INSECTS

By E. L. Worsham, *State Entomologist, Georgia*

The title of this paper designates a consideration of spraying apparatus and accessories, particularly with reference to their use in controlling the Coccidæ. Generally speaking, any good modern pump is equally well adapted to spraying both fungicides and insecticides. In certain respects, however, which are primarily concerned with the physical nature of the spray material, the efficiency of the different types of spray pumps is somewhat variable. The reason for this variation is hereinafter discussed more fully under the head of pump construction.

There is spraying apparatus of all kinds and sizes, and the selection of an outfit is, therefore, based on its service requirements. Beginning with the smallest of all, the bucket pumps which may be had for a few dollars, the sizes and costs will increase on a more or less graduated scale up to the 200-gallon power pumps which cost several hundred dollars.

Strong competition in the spray machinery business is responsible for the rapid improvement in the construction of pumps and accessories. It is now possible for the purchaser to obtain good, durable and efficient pumps from a number of manufacturers and at a cost entirely commensurate with their value. Individual operators have a large field in which to exercise their choice, though such choice would necessarily be founded more upon some peculiar mechanical device than upon cost.

Bucket and Knapsack Pumps

These two styles are grouped together because their field of usefulness is so limited. With sufficiently long leads of hose they may be used on small orchard trees, but they are designed and built ostensibly for use in spraying greenhouse plants and shrubs. Their relatively small cost places them easily within reach of all who have ornamental plants to protect, both indoors and out, from scale insects, and in this field they make valuable acquisitions to the garden, the greenhouse, and in the growing of small ornamental plants.

The bucket pump as a rule is constructed so as to extend into the bucket, to which it is attached by a clamp: a foot piece extends to the ground and by placing the foot upon this the pump is held in position while it is being worked. The cost varies from $5 to $10.

The knapsack pump being more portable and somewhat larger, is a more desirable contrivance for use in the sphere above assigned to the bucket pump. It is attached to the back after the fashion of a knapsack and is worked by a lever extending over the operator's shoulder. The details of construction vary between the different manufacturers, but the general plan is much the same in all. They are of five gallons capacity and are equipped with 3-8-inch hose to which any style nozzle may be fitted. The tanks are made of brass or galvanized iron and the prices are governed by the metal used in their makeup. The list prices vary from $10 to $18.

Barrel Pumps

Barrel pumps, as the name denotes, are pumps intended for mounting in barrels, and their size, cheapness and general efficiency for spraying on both large and small scale make them, perhaps, the most important

type of spray pump. When fitted out with good accessories they are capable of spraying the largest fruit trees under ordinary conditions and by far the larger part of all orchard spraying is done with pumps of this class. Practically the same principles are incorporated in the manufacture of the different makes, though the details of construction vary greatly.

It may be well in discussing this pump to consider what the essentials of a good pump are.

To begin with, it is necessary to have an air chamber to insure a steady spray, otherwise the spray would be intermittent and pulsating. The air chamber may be either separated from the working parts of the pump or combined with them. In some styles it is on top of the barrel, but in the more satisfactory types it is within, and in the latter the stability of the pump is greater. A large air chamber on the top of the barrel renders it top heavy, and this top heaviness is likely to be responsible for accidents when spraying on rough land.

One feature of the barrel pump that is yet far from perfection is the agitator. In most forms the paddle agitators are used, but these, while they are all that could be desired for spraying materials free of solid matter, will not and can not keep sprays such as the home-made lime and sulphur thoroughly mixed. The tips of the paddles describe an arc of about 45° and work so slowly that the lime quickly settles to the bottom with the result that the first part of the material as it comes from the barrel carries much more free lime than the last, which has but little.

The question of the agitator for barrel pumps is an important one and one that has not heretofore been satisfactorily solved. It is only in gas power sprays that this feature is perfected. However, for the materials now being used against scale insects which are uniform in composition and carry no solids, an agitator is wholly unnecessary.

The working parts of a pump, namely, the valves, valve seats, plunger and cylinder, should be made of metal resistant to the corrosive action of the spray material. These are usually of brass, bronze, or porcelain, substances not corroded by the action of the liquid.

A pump should be compactly built with all the working parts closely fitted so as to prevent leakage and attendant loss of power. All parts should be easily removable for cleaning purposes and to make repairs. Much trouble may be avoided by using only the best packing for the plunger. The standard asbestos is far superior to leather or cord, being more resistant to the caustic action of the spray and in every way more durable and satisfactory.

The spray pump market supplies a large number of different makes of barrel pumps. Those best known to the author are the "Deming,"

manufactured at Salem, Ohio; the "Friend," manufactured at Gasport, N. Y., the "Gould," at Seneca Falls, N. Y., the "Bean," at Cleveland, Ohio, and the "Hardie," at Hudson, Mich. The last has the pump mounted in the side of the barrel instead of the top, and this feature makes it particularly adaptable for spraying on rough steep hillsides. By building a frame work to the front trucks of a wagon and attaching the barrel thereto, the pump may be operated by the driver from the ground. The frame work being a continuation of the shafts, gives the barrel an angle which brings the pump handle to a position from which it can easily be worked by the driver. This pump when so arranged is especially valuable for use on land not really accessible to a wagon.

Any of the pumps above named are good, reliable makes, and with proper care will last indefinitely. They are sufficiently powerful to generate and consistently maintain pressure for the two leads of hose carrying a total of four nozzles.

Horizontal Pumps

This type of pump is designed for spraying on an extensive scale. It is larger and more powerful than the barrel pumps and is capable of supplying four leads of hose. The air chamber is of greater capacity and, therefore, capable of storing more air pressure than the smaller types. The plungers are usually differential and thus an equal pressure is exerted on both strokes, making the pumps double acting. With these, as with the barrel pumps, the principle of construction is practically the same. There are many differences of detail, and it is in the details that each manufacturer claims superiority over his competitor.

Horizontal pumps are intended for attaching to wagon tanks of from 100 to 200 gallons' capacity. They may also be bolted to a heavy lead and operated in connection with an ordinary fifty-gallon barrel. Primarily, however, they are designed for tanks and for heavy work on a large scale.

This style of pump may be, and usually is, operated by hand, but it is usually fitted up with a pitman or similar device for connecting to a gas engine. The Bean Pump Company are manufacturers of a pump of this kind that includes a heavy-coil spring for equalizing the efforts necessary to operate the pump handle. On one stroke energy is stored into the spring by the pull against its resistance and the resultant compression, and in the return stroke the stored energy contained in the compressed spring is released and the expansion helps the operator in forcing the liquid into the air chamber against full gauge pressure.

The working parts of horizontal pumps are not immersed in the spray material as is the case with most pumps of smaller size. The air chamber is connected to the material supply by a piece of heavy rubber piping, and is filled by suction. Repairs are more easily effected than with barrel pumps which have to be removed from the barrels, sometimes when the latter are full of spray material, before the seat of the trouble can be reached.

The cost of the horizontal pump ranges from $25 to $50. Nearly all the pump manufacturers have their cheaper and their better grades with an accompanying price list to match.

Power Pumps

Power pumps are of two kinds, (1) gasoline and (2) compressed air or compressed gas. With these machines it is possible to maintain the air pressure at a higher and more constant figure than with hand motive power. The maximum degree of success in spraying against scale insects is obtained only when the spray is driven onto them in a finely divided state and with force. The greater the force the greater the efficiency of the work, all other conditions being equal. Power outfits meet this essential requirement better than those operated by hand, for the reason that they can maintain a higher pressure and hold it practically constant. For general efficiency and labor saving they are superior to other types, especially in large commercial orchards, parks, etc.

Gasoline Power Pumps

All the leading power pump manufacturers turn out regular power pump outfits and they are giving general satisfaction wherever used. The original purchase price is, of course, much higher than for hand pumps, but thereafter they may be operated at a smaller cost and the additional cost in the beginning represents economy in the end.

Power pumps can certainly maintain high pressure for four leads of hose and have a capacity of 200 gallons per hour. Their greater weight makes them ineligible for use on land of a rough or hilly nature, but on flat land they are the most efficient and most rapid sprayers on the market, and their value as time and money savers is being more generally understood and appreciated than ever before. They are cheaper, too, than at any time in the past. A spraying outfit with gas engine, pump, lead, hose, etc., may be bought for sums varying from $135 to $300. The gasoline engines may be used for other farm purposes as well.

One feature of the gasoline power outfits, wherein they outclass any other type of pump, is the matter of the agitator. By attaching

the agitator to the engine, the paddles may be run at a rapid rate of speed and the spray material kept in a violent state of agitation. Where home-made lime and sulphur or other materials carrying solid matter are used this form of power pump is superior to any other.

Compressed Air Pumps

This class of pump is of two kinds, *i. e.*, those that are air charged at a fixed station, and those that compress the air into a cylinder by means of an apparatus connected with the rear wheels of the spray wagon. Both of these types are worthy of recommendation under certain conditions. Where no part of the spray solution will settle out, as when miscible oils, prepared lime and sulphur, etc., are used, and no agitation thereof is necessary, pumps that are air charged at the renewal station are highly efficient. Pumps that depend on the automatic compression of the air from the turning of the wagon wheels are efficient when the trees are small and can be rapidly sprayed. They are failures among large trees that require some minutes to spray before any advance is made. Neither of these types has adequate agitation equipment and other means must be employed wherever necessary to keep the material well mixed.

Carbonic Acid Gas Pumps

The working principle of carbonic acid gas pumps is almost identically like the compressed air type, except that the cylinder is charged with carbonic acid gas instead of air. It is an efficient, serviceable pump, but with respect to the agitator it is equally as inefficient as the compressed air pumps.

Spraying Accessories

No pump, no matter how capable, will give service without the complementary support of good spraying auxiliaries of the best quality and design. As much attention should be given to these as to the pump itself. These accessories consist of hose, extension rod, stop cocks and nozzles.

Hose

Nothing need be said of this save that it should be of the best quality and ample length. As a matter of economy, it is cheaper to buy the best grade of four-ply goods. This will easily last a full season or longer with proper care. Cheaper grades are quick to leak and are generally unsatisfactory. The better grades of hose cannot be bought for less than fifteen cents per foot.

Extension Rods

No spraying outfit is complete without an extension rod. It is an indispensable adjunct in reaching to all parts of the trees, expediting the work and improving the quality of the spraying. Besides these advantages, it is a protection to the operator, enabling him to evade a wetting from the spray mist as it is blown or drifted about. Rods are usually made of 1-4-inch piping and are cut to any desired length based upon the requirements. Bamboo rods are also used for the same purpose. Piping may be cut in short lengths and lengthened or shortened at will to suit the occasion by means of couplings.

Stop Cocks

Stop cocks are very serviceable and almost imperatively necessary in large spraying operations. By cutting off the flow they prevent waste in moving from tree to tree and are invaluable to successful and economical spraying. There are only a few types, the best of which is the brass stop cock with stuffing box that may be tightened so as to prevent all leakage. This type has a cut-off handle two inches long extending on just one side of the stuffing box and readily cut on or off by the thumb.

Nozzles

There are nozzles of all kinds and sizes and one must be governed by the requirements in each case. In spraying for scale insects it is of prime importance to use only nozzles throwing a finely divided spray. Maximum good results are obtained from nozzles insuring this important feature.

The best types of nozzles used in Georgia are the Vermorel, Bean, Friend, and Mistry, Jr.. These may be attached to the rod singly, in couples, or sets of three or more. In the writer's opinion the best nozzle now on the market is what is called the Mistry, Jr. The Bean Manufacturing Company also make similar nozzles. In this type the construction is exceedingly simple; they do not easily become clogged and are readily cleaned when the flow becomes obstructed. They are without the degorger common to the Vermorel type and the objectionable features occasioned by the catching of these prongs on the limbs, pulling off the fruit, etc., are eliminated. Their extreme simplicity, the ease with which they are cleaned and the rapid and thorough work they insure puts them well at the head of the list in the world of nozzles.

PRESIDENT SANDERSON: These three papers open up a wide field for discussion.

MR. SYMONS: I would say that I feel some hesitation about discussing this problem beside Mr. Worthley, who has so ably presented the matter of spraying in the New England States. He gives some good reasons why the price of rubber has gone up. We hear of the miles of hose they have used. There are some points I glean from these papers, with which I do not entirely agree, but on the whole they are very instructive. Referring to the point made in regard to the use of the barrel pump, and a man maintaining two leads of hose, I would say I would not like to be the man to keep the nozzles busy. There is another point, I note that two of the papers do not advise the use of gear sprayers. We have found in our state that in some respects gear sprayers have given considerable satisfaction. It certainly is to be said they are not designed for treating large trees. We previously had a gasoline engine made in accordance with our own ideas, and the men have absolutely abandoned that engine for the Brown gear sprayer. Now, in regard to the sprayers on the market, it seems to me the manufacturers have been slow to take up some points we have made in regard to spraying machinery. I know at least one firm which continues to make pumps with large air chambers above the barrel, which I believe we all concede is rather impractical. Moreover, the power sprayer is the coming sprayer, and of that kind I would say the Friend seems to be predominant. But, even with that outfit, I believe that they can reduce the weight of the engine. The one we previously used weighed only ninety pounds, and gave satisfaction, while the larger engines, the Goulds and others, weigh from 300 to 400 pounds, and certainly it seems as if they could reduce that weight. I think the suggestion made by Professor Ball in regard to a tower is an excellent one.

MR. HEADLEE: Our time is very short, and I think the ground has been thoroughly covered. I wish to touch briefly on one point—spraying by means of compressed air. In large orchards compressed air appears to be one of the very best sources of power. Mr. George Richardson of Tonganoxie, Kan., has gotten together the necessary machinery and has used compressed air for several years in treating his large orchard. He said to me at Christmas time, "If I did my spraying as most fruit growers do it, I would have to have four or five expert engineers, and that would mean a large expenditure of money. As it is now, I have one capable engineer and a good air compressor, and I keep my three wagons going all the time." He claims to spray 8,000 to 10,000 gallons a day. His apparatus, including the plant for making lime-sulphur wash, represents an investment of about

$3,000. I happen to know that he never stops to spray a tree, but goes straight along. He has the men on platforms on the side of the wagon, and the wagon starts right off down between the rows, throwing the spray in a perfect cloud as it goes. As soon as the tank is empty, the next wagon comes up with its full tank, and connections are immediately made. The liquid is agitated by delivering compressed air at the bottom of the tank, and a precipitate is never found in the emptied tanks.

SECRETARY BURGESS: The power sprayers on the market are assembled, that is, they are not built by one firm, and as a rule, the pumps are made for other purposes than spraying. The engines are also built for other purposes. Most of them are heavy stationary engines, which are simply hooked up with some pump. It seems to me that what is really needed is a spraying machine that is built for the purpose of spraying, rather than spraying machines that are built by assembling various parts—pumps, engines, etc.—which have been designed for other purposes. Professor Symons mentioned the idea of spraying from a tower. I believe the time is coming when we will give the fruit grower an equipment so that he can spray from no higher point than the top of the tank, or from the ground. I believe the system of solid stream spraying, properly adapted—it must be worked out and experimented with—can be used in any orchard, and the operator can spray from the ground.

MR. SYMONS: Those who spray for truck crops say that the Hillman sprayer has been found very satisfactory. It has a double acting pump which can be used for spraying trees if desired. There are several other satisfactory ones on the market.

PRESIDENT SANDERSON: I think it is very evident that we could spend more time on this subject. No one has mentioned the use of the gasoline engine with compressed air. It is very evident to all of us that what Mr. Burgess has said about the attitude of pump companies is very true. The insecticide companies have gone away in advance of the pump companies. I would like to suggest that when this symposium is published, it might be a good idea to send a marked copy to each of the pump companies. The next paper will be read by Mr. Webster.

SPRAYING WITH LINSEED OIL WASH FOR THE OYSTER-SHELL SCALE

By R. L. Webster

At the Boston meeting of this association Prof. R. A. Cooley read a paper giving the results of tests of several spray materials for the oyster-shell scale. One of the most promising of these was a linseed oil emulsion. The writer has been trying a number of materials against this scale in Iowa, but with no success, and so this linseed oil wash was given a trial last spring.

Professor Cooley's formula, which I used, is given herewith:

Hard soap	1 pound
Raw linseed oil	1 gallon
Water to make	12 gallons

The soap was dissolved in a small quantity of water and an emulsion was made with the oil. This was diluted while warm to the required strength.

The mixture was used during the hatching period of the insect, which was long drawn out last spring. One spraying was made May 13 and another May 18, in a badly infested orchard at Ames. Both sprayings were very effective; far better than the lime-sulphur wash or any other mixture that I have tried.

The linseed oil wash adhered to the trees very well. It was still conspicuous as late as July 22. There was no injury to the leaves; in fact, the foliage was in excellent condition all summer. The season was exceptionally dry.

The young scale insects were plentiful on the trees when they were sprayed. The spray evidently killed most of the young which had settled down and it also prevented others from establishing themselves on the bark. Very few live insects were found on the sprayed trees later in the season. The earlier spraying, that of May 13, seemed to be slightly more effective than the later one.

From time to time unsprayed trees in an orchard just across a railroad track were compared with the sprayed trees. The unsprayed trees were badly infested, like the sprayed trees. Living scales were very numerous during the late spring and summer on the unsprayed trees, while a live scale was found only here and there on the sprayed trees.

The cost of this linseed oil wash is a serious drawback on its use. Raw linseed oil has been quoted to me F. O. B. Des Moines at $1 a gallon in 10-gallon lots, or 97 cents a gallon in 50 or 100-gallon lots. At this rate the mixture would cost about nine cents a gallon.

PRES. SANDERSON. The next paper will be read by Mr Symons.

THE TERRAPIN SCALE IN MARYLAND

By T. B. SYMONS and E. N. CORY, *College Park, Md.*

[Withdrawn for publication elsewhere.]

PRESIDENT SANDERSON: Is there any discussion?

MR. SMITH: I was interested in Professor Symons' paper. We had that scale in one of our counties. It is the only county in the state of New Jersey where it has done great injury to the trees, more than in Maryland. It has a tendency to kill the twigs, and so very largely causes the loss of fruit. I found we could prevent this habit of going out on the twigs by pruning, and we have advised pruning to good effect in some instances. Professor Symons said definitely that he had no success with lime-sulphur, which I knew before, as we had not had in our state. He also said he used miscible oils in the fall, and in the spring he used scalecide. We used this, but not so strong as Professor Symons did, on one man's trees. He said the conditions were so bad that he was willing to do almost anything to save his trees. I advised him to use crude oil, with the understanding that it was a kill or cure remedy.

PRESIDENT SANDERSON: I would say I have omitted two papers by Professor Gossard. Possibly we could hear from Professor Gossard now.

ENTOMOLOGICAL REVIEW OF THE YEAR 1910

By H. A. GOSSARD, *Wooster, Ohio*

From the observations of our staff and the correspondence of the year I have selected the following notes as possessing sufficient interest to report for publication:

Among our field tests scalecide was tried in both fall and spring applications compared with commercial lime-sulfur and also with home-made concentrated lime-sulfur made according to the formula given by the Pennsylvania Experiment Station. About 20 acres of young apple orchard with bearing peach trees for fillers were subjected to this comparative test. All of these applications were practically effective against San José scale, leaving scarcely any survivors at all. So far as it was possible to discover any distinctions at all between the results of the different treatments, there appeared to be a few more scales on the oil sprayed trees than on those treated with the lime-sulfur mixtures, but from a practical standpoint all the results

were satisfactory and to cursory observation almost indistinguishable. Part of the home-made concentrated lime-sulfur was kept over winter and used in the spring. Some sediment formed in this home-made concentrated product and we were not able to satisfy ourselves that it would in all cases be equal to the commercial brands, although our result from the field test seemed quite satisfactory.

We used lime-sulfur and arsenate of lead combined for spraying apples and obtained more satisfactory results with this mixture than with arsenate of lead combined with bordeaux or with bordeaux to which sulfate of iron had been added. Seven orchards aggregating about one hundred and forty acres in extent and located in different quarters of the state were employed in these tests. The results on both foliage and fruit with the lime-sulfur mixtures were superior to those obtained with the other combinations, but were not perfect by any means in some respects. For instance, we russeted the fruit very noticeably on some varieties, though not so badly as with the other sprays. That variety influences the result with this spray exactly as it does when bordeaux is used seems proved to us by the difference noticed in the apples in our variety orchard at the experiment station. Trees of different varieties standing in the same row and sprayed from the same tankful of material and only a few minutes apart, would exhibit all gradations of russeting from perfect skins without suspicion of a blemish to cracked and distorted fruit that could easily serve as illustrations of bordeaux injury. But the aggregate of damage was much less than where bordeaux was used in the same orchard, and the foliage was in all respects better. The horticultural department of the station gathered the notes on these varietal results. In southern Ohio three sprayings with lime-sulfur, once before bloom, just as the buds were beginning to show pink, a second time in combination with arsenate of lead just after bloom, and a third time in late July, failed to satisfactorily control the leaf-spot or frog-eye fungus (*Sphæropsis malorum* and *Coniothyrium pirini*) though results were better than with bordeaux. An inspection made in early June showed a wonderful difference in favor of the lime-sulfur as compared with bordeaux, but later developments more nearly balanced the comparison. A late freeze destroyed all of the fruit on this orchard and we obtained results on foliage alone. Commercial lime-sulfur was used in all of these tests. The degree of dilution was about one to thirty, and was reduced to uniform strength for the tests by hydrometer determinations.

We used self-boiled lime-sulfur combined with arsenate of lead on peaches, plums and cherries, using an orchard of about five acres each of plums and peaches, and about one-half acre of cherries, the

latter containing both sweet and sour varieties. The plums were sprayed as soon as the petals were down and the fruit well set, the cherries soon after the falling of the bloom, but not till the fruit was as large as peas, and on the peaches we made the applications practically as directed by Professors Quaintance and Scott in Circular 120 of the Bureau of Entomology. A second application was given to the plums and peaches about four weeks after the first, and a third was given to some of them in late July. For comparison a block of each sort of fruit represented: viz., peaches, plums and cherries, was sprayed with bordeaux mixture combined with arsenate of lead, and others with bordeaux plus iron sulfate and arsenate of lead. The commercial lime-sulfur diluted with 100 parts of water and combined with arsenate of lead was also applied to small plots of each of these three kinds of fruit. The superiority of the self-boiled lime-sulfur over the other mixtures was very apparent as regards both foliage and fruit. What with the dry season and the spraying together, almost no brown rot appeared, very little curculio developed and the crop was the best, on the whole, ever harvested from the orchard. The results with the commercial lime-sulfur with the dilution tried were fairly satisfactory, more so than with the other materials except the self-boiled wash. One striking incidental result was the effect of the lime-sulfur wash on aphids in these orchards. So striking was the contrast between the trees sprayed with this material and those sprayed with bordeaux that strangers would stop to inquire why certain trees were so lousy while their neighbors in the adjoining row were so clean. A difference in this regard was likewise noted in the apple orchards under treatment, and it seems to me that we have good grounds for hoping that with the general adoption of this spray, the woolly aphis and its attendant diseases of blight, canker and collar rot will become much less prevalent. This insect was unusually bad over all Ohio last season, attracting far more notice from orchardists than in any year of the last six. We found the young of both the scurfy scale and the oyster-shell scale appearing at just about the time for making the first spraying for codling worm, and hope the lime-sulfur used at this time as a fungicide will also greatly reduce the numbers of these. Owing to the early season in Ohio we thought possibly San José scale would appear a little earlier than usual, but so far as we were able to determine from observations at Wooster, and from samples reaching us in the ordinary course of mail, the young began to appear at the usual time, or about the middle of June in northern Ohio.

We have continued our experiments with bark beetles in northern Ohio along the lines which seemed from the preceding two years' experience to promise most. In a few cases trees that had been white-

washed were badly attacked, but our previous recommendation that three whitewashings be given per year, one in March or April, a second in July and a third in late September or early October, seems to hold good on the average, and we feel confident that this program of treatment, if carefully adhered to and the work is thoroughly done, will control these pests, provided cultivation, pruning and fertilizing are intelligently combined with it. There is no doubt that the 12 per cent emulsion of carbolineum avenarius is more effective in controlling the beetles, but we have not always had entirely satisfactory results upon the trees following its use. On the 2d of June Mr. Whitmarsh found adults of *Monarthrum fasciatum* appearing in great numbers upon two peach trees near Danbury, Ohio, the trees having been fairly riddled by them. He was not able to locate the species elsewhere. We have not been able to find any previous record of this species attacking peach. The Red Shouldered Sinoxylon, *S. basilare*, in peach wood was received from a correspondent.

We tested the properties of iron oxide which had been used for purifying gas and thrown out as a refuse product from the gas factory, as a remedy for white grubs. Five or six acres of land was subjected to test and several tons of oxide were used. It was applied at the rate of 3,000 pounds per acre, 4,000 pounds per acre and 6,000 pounds per acre, or rather the fertilizer drill was set to sow fertilizer at these rates. The oxide did not feed so fast as fertilizer and the actual weights applied were about 66 per cent of these figures. On one of the potato patches this was applied about one month before planting time and the land was thoroughly disked and cross-disked to evenly distribute the oxide through the soil. An extra harrowing was given later to prevent weeds from starting. On most of the plots no difference could be detected in the results, the checks appearing in all respects like the treated plots. Growth was apparently interfered with on the plots receiving the heaviest applications and the stand of plants on these was noticeably thinner than over the rest of the field. The material was applied to one field just before planting and the stand in this field was perceptibly reduced. Living grubs could be found in the treated blocks long after the treatment was given and so far as we were able to ascertain they were scarcely interfered with at all. If the grubs had been more abundant it is possible that results would have been more apparent, but we hardly anticipate great results from this treatment. Grubs have elicited many inquiries at the Ohio station during the past three years. We made one test to determine the comparative merits of arsenate of lead and of powdered arsenate of iron when used for the Colorado potato beetle. Both poisons were applied in combination with bordeaux. A double appli-

cation was made with a Spramotor field sprayer and the beetles were practically annihilated by both poisons, but it required several days longer for the iron compound to fully accomplish its work than the lead poison.

In Paulding County considerable damage was done to young corn by the very common crambid webworm, *Crambus trisectus*. A number of fields had to be replanted and the stand in many others was greatly thinned. Except this species, I could find only a single caterpillar of *Crambus caliginosellus* concerned in the damage. Where corn had followed corn, there was no damage, but over pasture lands and stubble fields of the preceding year, the worms were abundant, as many as a dozen being quite readily found in some hills of corn. I found the worms feeding freely about the roots of clover and proved by observation that they could readily subsist on this plant without other food. The farmers reported that some of their Indiana neighbors had some success in controlling the worms by the use of a fertilizer attachment to the corn planter by which a quantity of tobacco dust was dropped in each hill. We had no opportunity to test the remedy. Grasshoppers were reported as more than usually destructive and numerous from several points in northwestern Ohio and from one locality in the southeastern part of the state. In northwestern Ohio chinch bugs have been more numerous the past season than for many years, and considerable damage was done to corn after wheat harvest. We distributed many packages of *Sporotrichum globuliferum*, but our cultures seemed to lack virility even under favorable conditions, and I question if we were not doing more harm than good by distributing it, for many farmers will rely altogether upon it and do nothing at all for themselves if the fungus is supplied to them. The wheat joint worm was less numerous than for three years, but was responsible for a good deal of damage. The Hessian fly was more numerous in the fall than for several years and we anticipate general and quite severe damage from it next season. We put out a press bulletin in early September advising rather late sowing, but would have been considerably more emphatic if we had sensed the full situation. The general and prolonged drought in many sections of the state retarded the appearance of the flies, and the copious rains of early October brought out all the stragglers with a rush and massed them at a date so late that even very late sown wheat was severely attacked in many instances. Our records at the station show that egg-laying had been under way and at quite a vigorous rate previous to the 19th of September, and continued throughout the month, reaching a maximum for the last eleven days of the month on the 26th and 27th. On the 8th of October, following three or four days of drenching

rain, eggs were being laid at the most rapid rate of the season. But few eggs were laid after this date at Wooster, though scattering ones could be found deposited daily until the 16th to the 20th of October. On the 13th of October I examined 143 plants taken at random from numerous points over the station wheat plots sown September 26 and 27. Of these, sixty-seven plants were clean and seventy-six of them had a total of 212 eggs on them, or 53 per cent of these late sown plants had on them an average of about three eggs each. Since many of these will perish before spring, even in case all hatch, we think this wheat safe, but evidently we are in more danger from this insect than we have been since 1900.

The plum gall mite is apparently on the increase in the state and each year we receive a few more reports from new localities than we did the preceding year.

The clover or pea louse, *Macrosiphum pisi*, became abundant in early summer, especially in northwestern Ohio and some fields died out after the clover was cut. Droughty conditions, undoubtedly, had much to do with its unusual abundance. The clover thrips also caused more inquiry than usual. The clover seed chalcis, which was extremely abundant for one or two seasons preceding the present, caused very little trouble this year, or at least it was not sent to us in sufficient numbers to attract our attention.

I saw one very interesting result of the use of formalin solution on onion seed at planting time. So successful was the mixture in preventing smut and giving the plants a vigorous start by which they were enabled to outgrow damage by root maggots, that some of the growers were inclined to think it possessed both fertilizing and insecticidal properties. It appeared to me to be of more value in enabling the plants to out-strip maggot damage than fertilizer applications would be. Our animal husbandman requested a formula for the destruction of flies at the hog barns. I recommended a solution of formalin and water, but he reported that he obtained little success with it until he used it in combination with sour milk and swill. After using it in this way, he was soon able to sweep bushels of dead flies from the floors. The catalpa midge continues to be the worst enemy of catalpa plantations. One of our correspondents sent us the common Carabid beetle, *Galerita janus*, with the report that he had more than once found it feeding voraciously on the young of the Colorado potato beetle. We caged the species with an abundance of young potato bugs, but were not able to verify the observation. The birch borer, *Agrilus anxius*, is causing much destruction to birch trees in the parks of Cleveland and Toledo. The corn pollen maggot, *Mesogramma politum*, has been reported from Newark for two successive

seasons by the same party as causing severe damage to his sugar corn. The clover hay-worm was reported from two parties as destructive to alfalfa in mows. The bumble flower beetle, *Euphoria inda*, was reported from several localities as unusually injurious to corn in the silk. *Euphoria sepulchralis* was also received once or twice with a similar accusation against it, or rather was included among the samples of *Euphoria inda*. The mealy flata, *Ormenis pruinosa*, and the green flata, *Chlorochara conica*, were both received in a sending of insects said to be exceedingly destructive to ginseng. The red-humped caterpillar of the apple was more than usually prevalent throughout the state as was also the oblique banded leaf-roller. The raspberry Byturus has been injurious locally, here and there exceedingly so, but its distribution in destructive numbers seems to be very restricted. The grape-berry worm has caused comparatively little damage and can scarcely be found in some of the neighborhood where it was so abundant a few years ago. The linden tree louse, *Lachnus longistigma*, was very abundant in Cleveland for the past two seasons rivaling its record in Washington city for 1889. The maple sesian, *S. acerni*, has been very injurious to maple trees for two or three seasons.

The potato scab gnat, *Epidapus scabei*, was located in a potato patch just in the outskirts of Cleveland. It was quite destructive; so much so that a request was filed with us for an investigation, and this led to its discovery. No seed had been imported onto the place for several years, from which we were obliged to infer that it was indigenous to the locality.

In the latter part of August, we received from Shandan, Ohio, the tenebrionid beetle, *Platydema ruficorne*, working in stored corn. They hollow out the grains while on the cob, and seem to possess all the capabilities for damage which characterizes a number of other pests in the same family. So far as we have been able to determine, nothing has been published hitherto regarding the life-history and habits of this beetle.

President Sanderson: Is there any further business before we adjourn?

Mr. Washburn: You were kind enough to include me in the mention of thanks for the entertainment here. The work at the Agricultural College has been done by my assistants, Messrs. Ruggles, Urbahns, and Stafford, and whatever thanks you offer are due in part to them.

There being no further business the meeting adjourned.

A. F. Burgess, *Secretary*.

[The following papers were read by title.]

NOTES ON THE LIFE HISTORY AND HABITS OF PEGOMYA BRASSICAE

By W. J. Schoene

Late cabbage is one of the important farm crops in many sections of western New York. In general the crop is profitable. It grows vigorously and thrives on many types of soils, and will usually make a crop even when conditions are somewhat unfavorable. The greatest obstacle to the successful culture of late cabbage is the cabbage maggot, *Pegomya brassicæ*, which attacks the plants while they are in the seed bed. The insects are so abundant some seasons that farmers are not able to grow sufficient seedlings for their plantings. Different methods have been adopted by the farmers to cope with the problem but in general they have not been successful. In taking up this problem it was apparent that no progress could be made in protecting seed beds until there was more definite data regarding the life history of the cabbage maggot, especially the period of oviposition of the first brood of adults. This insect has received attention for three seasons and it is desired to present some of the results of this study.

Oviposition of the First Brood of Flies

To determine accurately the period during which the bulk of the eggs are deposited was an important part of the problem. The observations recorded in Table I were made by examining each day, or twice every three or four days a varying number of plants grown in the open field. The usual procedure was to remove the eggs and soil from a number of plants and add other soil containing no eggs. After an interval of a few hours the same plants were examined and the number of eggs noted. The data presented is intended to show the period of greatest abundance. It is probable that our notes do not show the first eggs deposited and it is quite certain that a few eggs were deposited throughout the month of June.

The Number of Days from Egg Deposition to Appearance of Adults

Believing that the widely divergent periods mentioned by various workers for the pupal period were unnatural, and that the insects under observation had been unduly influenced by laboratory conditions, the following experiment was planned in order to place the insects as nearly as possible under the same conditions as those in the field. In 1909 a number of 8-inch flower pots were filled with sterilized earth and in each were planted cabbage plants that had been grown in the greenhouse. Before transplanting, the plants were

TABLE I

PERIODS OF MAXIMUM EGG DEPOSITION BY FIRST BROOD OF ADULTS DURING 1908–09–10

Date	1908	1909	1910
May 10	....	....	....
12	....	....	....
14	....	....	....
15	Very few	....	Very few
16	....	Very few	....
17	....	....	Few eggs
18	....	Few eggs	....
19	....	....	....
20	....	....	....
21	Abundant	Abundant	Very abundant
22	....	....	Very abundant
23	....	....	Abundant
24	Abundant	Few	....
25	Abundant	....	....
26	....	....	....
27	....	....	....
28	....	Very few	....
29	Very abundant	....	....
30	....	....	....
31	Abundant	Very abundant	Abundant
June 1	Very few eggs	Very abundant	Abundant
2	More numerous	....	....
3	Abundant	....	....
4	....	Abundant	....
5	Abundant	....	A few eggs
6	Few eggs	....	....
7	....	....	....
8	....	....	....
9	Very few	....	No eggs
10	....	Not so numerous	....
11	....	No eggs	....

carefully examined to insure their freedom from eggs and maggots. The pots were then covered with cheese cloth to avoid parasites and reinfestation. In 1910 the work was repeated in the same manner, except that a modification of the "Tower" cage was used instead of the pots. Eggs were then placed on the soil close to the plants. With the exception of renewing the food in some of the breeding cages of 1909, the insects upon hatching were permitted to feed, pupate and emerge without interference. Both seasons the cages were sunk in the soil, and it is believed that the moisture and temperature conditions were about the same as in the surrounding earth.

In 1909 only twenty-three adults were bred from eleven breeding pots, the small number being due possibly to dry weather and insufficient food. The period from egg deposition to appearance of adults ranged from twenty-seven to sixty-one days, with an average of forty-three days. Eighty-two per cent of the individuals emerged within forty-five days.

The record for 1910 is shown in the following table:

TABLE II

RECORDS OF THE NUMBER OF DAYS FROM EGG DEPOSITION TO APPEARANCE OF ADULTS, IN BREEDING CAGES, AT GENEVA, N. Y., DURING 1910

Eggs deposited May 15, 1910			Eggs deposited May 17, 1910			Eggs deposited May 23, 1910			Eggs deposited June 5, 1910		
Date flies emerged	No. of flies	No. Days	Date flies emerged	No. of flies	No. Days	Date flies emerged	No. of flies	No. days	Date flies emerged	No. of flies	No. days
June 20	2	36	June 22	1	36	July 2	4	40	July 9	3	34
21	2	37	23	1	37	3	5	41	10	3	35
25	2	41	July 1	2	45	4	2	42	14	1	39
27	1	43	4	1	48	5	2	43	29	2	54
July 18	1	64	5	1	49	6	6	44	Aug. 13	2	69
Aug. 10	1	87	6	1	50	7	2	45	15	2	71
......			27	1	71	8	2	46	16	1	72
......			Aug. 13	4	88	17	1	55	17	2	73
......			......			27	3	65	......		
......			......			Aug. 13	4	82	......		
......			......			16	2	85	......		
......			......			17	4	86	......		

The extent of time from the laying of the eggs to the appearance of the adults, ranged from thirty-four to eighty-eight days, with an average of fifty-five days. Fifty-four per cent of the adults emerged within forty-five days.

Larval Stages and Number of Days Required for the Larva to Mature

Efforts to breed the insect in the laboratory and to observe the larval ecdyses have not met with success. Some cast-skins were secured, but not with sufficient regularity as to be certain of the stages. The data given below in Table III was secured by growing in the laboratory a number of larvæ which were hatched the same day. Each succeeding day several of these were killed and preserved. By this means a series of larvæ were obtained which ranged in age from one to eighteen days. One or more larvæ of each lot was measured and the cephalo-pharyngeal skeleton mounted in balsam. A study of the chitinous structures indicate three well-marked stages for the

Fig. 5. Relative sizes of cephalo-pharyngeal structures of 1st, 2d and 3d stages of larva of *Pegomya brassicæ*. Camera lucida drawings x 65. (Original.)

larvæ. These instars may be known by the difference in the size and shape of the cephalo-pharyngeal structures. The increase in size of the different individuals of the series was not proportional to the age. In some instances larvæ of the same age would vary so in size that one would be three times as large as the others. These variations did not appear in the chitinous structures of these individuals. Aside from the differences in size which mark the three stages, there is a thickening or blackening of the chitin which becomes very pronounced in the older larvæ. Thus the amount of pigment, together with the size of the skeletal parts would indicate the age of the larvæ more closely than the dimensions of the individual.

In the examination of the larvæ previous to the separation of the chitinous structures, it was noted that all the larvæ possessed the bifed caudal tubercles ascribed to *brassicæ* by Fitch in his eleventh report.

TABLE III

COMPARATIVE MEASUREMENTS OF THE CEPHALO-PHARYNGEAL STRUCTURES AND OF THE SIZE OF THE LARVÆ

Age of larvæ in days	Length of dorsal sclerite of cephalo-pharyngeal skeleton	Length of larvæ	Diameter of larvæ
1	136 microns	1.25 mm.	....
2	136 "	1.75 "	....
3	289 "	1.75 "	....
4	323 "	1.75 "	....
6	340 "	3.25 "	....
7	329 "	3.75 "	....
8	314 "	3.75 "	....
9	612 "	5.50 "	....
11 A	527 "	5.50 "	1.50 mm.
11 B	612 "	2.50 "	1.00 "
13	535 "	4.50 "	1.50 "
14	612 "	4.50 "	1.25 "
15	561 "	5.50 "	1.50 "
16	586 "	7.00 "	1.75 "
17	612 "	5.50 "	2.00 "
18	612 "	6.50 "	1.75 "

Aërial Habits of the Larva

The question of removing the stumps from the field after the cabbage crop has been harvested has frequently been discussed by entomologists. The advisability of such a procedure depends upon the numbers of injurious insects that would be killed or avoided. To obtain data on this point a number of fields were inspected in this locality and on Long Island.

The stumps examined, and especially those from which "early" cabbage had been cut; were found to contain maggots. Some of these were feeding upon the root, but the majority of them were found in the upper part of the stalk, at the base of the leaves and in the cortex of the adventitious buds. The maggot has generally been considered a subterranean insect, and little mention seems to have been made to an aërial habit. The fact that in some fields a large percentage of the larvæ work in the top part of the plant during September and October is thought important because of the possibilities of reducing the numbers of these insects by the timely removal of these crop remnants. Adults and eggs have been observed in considerable numbers about

these adventitious buds, and their presence is partly understood because of the great numbers of these buds or sprouts that appear after the cabbage is cut. It is probable that the adults are attracted to the "sprouts" because of the tender growth. Rough estimations, based on the examination of 50 to 100 plants in each of a number of fields indicate from 300 to 1,500 maggots per acre.

Effect of Plowing on Pupæ

For this experiment a seed-bed badly infested with maggots was selected. The injury to the roots of the plants in this bed was so general that the entire planting was abandoned by the owner. The soil was very light and sandy, and the plot on which the bed was located had just enough slope to carry off the surface water. Two portions of the bed in which the injuries seemed equal were chosen, and on June 23d one was plowed to the depth of six or seven inches and harrowed. The next day a small cheese-cloth screen 6 x 24 feet, such as is used in this locality for the protection of seedling cabbages, was erected over each part. (Bul. 301, N. Y. Sta.) As the flies emerged from the soil they were collected, the dates and numbers taken being as follows:

TABLE IV

THE DATES OF APPEARANCE AND NUMBER OF FLIES COLLECTED FROM PLOWED AND UNPLOWED SOIL AT SENECA CASTLE, N. Y., DURING 1909

Date	Unplowed	Plowed
June 29	141	51
July 1	193	21
3	170[1]	28
5	151	24
7	74	16
9	47	20
13	8	26
17	36	35
21	18	4
26	15	0
30	11	5
Total	864[2]	230[2]

As shown in the above table only about 27 per cent as many flies emerged from the plowed as from the unplowed plot.

[1] Numbers estimated.

[2] About 10 per cent of the males in these collections were *P. fusciceps.*

The difference in the numbers collected from the two plots was so apparent, from the first, that a yard of the soil adjacent to each of the screened beds was sifted to determine the relative position of the pupæ in the plowed and the unplowed soil. The first and second three inches of soil were sifted separately. The numbers of pupæ found are recorded in the following table.

TABLE V

EFFECTS OF PLOWING ON DEPTH OF PUPÆ IN THE SOIL

	Number of pupæ in first 3 inches	Number of pupæ in second 3 inches	Total	Per cent of pupæ in first 3 inches
Unplowed soil .	74	5	79	93
Plowed soil.....	19	32	51	37

It should be noted that in the square yard of plowed soil only 37.2 per cent of the pupæ were found in the first three inches, while in the unplowed plot 93 per cent were found in the first three inches.

It seems hardly possible that the facts as presented could be accounted for, other than the direct effect of cultivation. Prior to this experiment the two plots were covered with seedlings at the rate of 200 or more per square yard and these were either killed or their roots so badly injured that they were unfit for use. For this reason it is thought that the numbers of pupæ in the two plots must have been approximately equal before the ground was plowed.

OVIPOSITION AMONG TREE-CRICKETS

By P. J. Parrott

In the Journal of Economic Entomology, Vol. 2, pp. 124–127, a brief account was given of the work of *Oecanthus niveus* De Geer on apples, and *O. nigricornis* Walker on raspberries. The present paper deals with observations on the egg-laying habits of these species and of *O. quadripunctatus* Beut. The crickets on which these studies were made were captured in the same raspberry planting, and single pairs of each species were confined in breeding cages in which were growing both apples and raspberries. The number under observation were ten pairs of *niveus*, six pairs of *nigricornis* and four pairs of *quadripunctatus*.

Egg Deposition in Apples and Raspberries

Recent studies have shown that *niveus* deposits its eggs in the bark of apple, plum and peach trees. Elms, willows and other trees are

also probably frequented for purposes of oviposition. The common occurrence of adults in raspberry plantations has raised the question if the species really oviposits in raspberry canes. Repeated examinations of vines in one planting have tended to cast doubt as to such a habit, and the evidence indicates that the cricket prefers other plants for the deposition of its eggs. When apples and raspberries were grown together in the same cage *niveus* invariably laid its eggs in apples, but in the absence of other plants it would deposit eggs in raspberries. *Nigricornis* and *quadripunctatus* always preferred raspberries, but when it had no alternative, *nigricornis* sometimes laid eggs in apple wood, usually selecting the tips of the new growth.

Process of Egg Deposition

In brief, the process is as follows: The female, having selected a suitable spot on the plant, first gnaws a hole in the bark. She then advances forward, and moving the ovipositor at right angles to her body, she inserts the tip of it in the wound and proceeds to bore the hole for the reception of the egg. The drilling is accomplished by a thrusting and rotating motion of the ovipositor. After boring to a suitable depth the egg is deposited. An adhesive substance is then discharged which is kneaded about the egg by the ovipositor; then withdrawing this organ, she reverses her position and completes the process by capping the opening with small particles of bark, which are held firmly in place by the mucilaginous substance surrounding the egg.

The actual time consumed in the process of egg deposition varies apparently with the species. The period of laying an egg also differs in extent with individuals of the same species. In ovipositing in apple wood of an inch and a half in diameter, adult females of *niveus* spent from seven to sixteen minutes in gnawing a cavity in the bark, from twenty-seven to seventy-six minutes in drilling with the ovipositor, and from three to five minutes in depositing and disguising the egg. The eggs are laid singly, and if the female is not disturbed as many as four eggs may be deposited in the neighborhood of each other during one night.

In depositing their eggs in raspberries females of *nigricornis* spent much less time in the various operations. From twelve to seventeen minutes were occupied in boring the hole with the ovipositor, and from five to eleven minutes in laying and disguising the egg and in gnawing an opening preparatory to drilling. As the preparation of a niche for the egg in raspberry canes by *nigricornis* is more rapidly accomplished than by *niveus* in apple wood, so the number of eggs

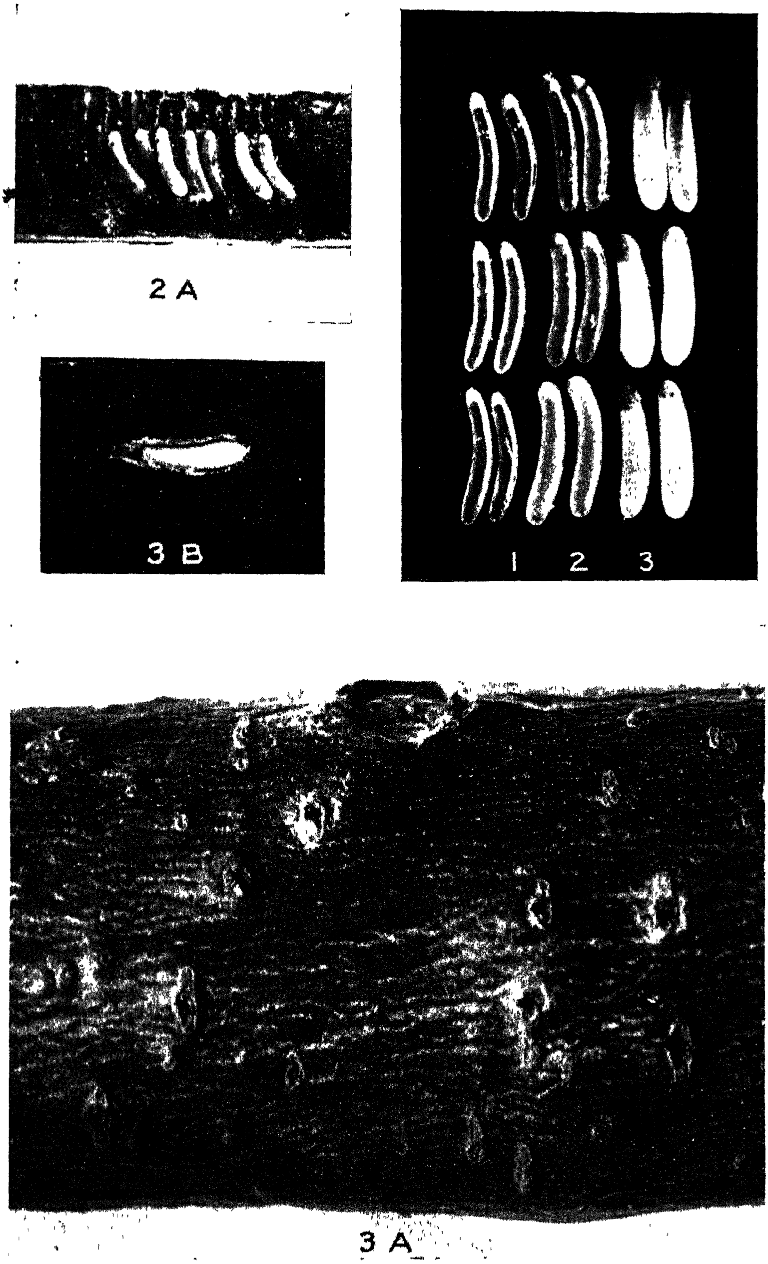
deposited in the same interval of time by the former will usually be higher than that of the latter. A female of *nigricornis* was observed to lay seventeen eggs in a cane during one night, which greatly exceeded the number deposited in the same time in apple wood by *niveus*. The eggs of *nigricornis* were laid in linear series. The number of eggs in a row are variable. Of twenty-five egg masses selected at random, the number ranged from one to eighty-one, giving an average of thirty eggs to a row. The number of eggs in a series is sometimes increased by several ovipositions at varying intervals by the same female.

The females of *quadripunctatus* in breeding cages deposited their eggs in rows similar to *nigricornis* in the petioles of the leaves. The injuries to the plant are not so extensive as with the latter species, and the scars are therefore much less conspicuous.

The oviposition period and the numbers of eggs deposited by the females of the three species are as follows:

OVIPOSITION PERIOD AND NUMBER OF EGGS DEPOSITED BY INDIVIDUAL TREE CRICKETS

Species	Oviposition period		Total number of eggs
niveus 1	Sept. 8 to Sept.	26	67
" 2	2	26	27
" 3	8	29	19
" 4	5	23	23
" 5	7	13	5
" 6	8	12	6
" 7	5	14	10
" 8	7	12	3
" 9	7	14	14
" 10	7	14	28
nigricornis 1	Aug. 29 to Oct. 1		165
" 2	Sept. 2 to Sept. 16		64
" 3	Aug. 30 to Sept. 3		26
" 4	Sept. 2 to Sept. 26		78
" 5	Aug. 29 to Sept. 6		52
" 6	Aug. 26 to Sept. 22		31
quadripunctatus 1	Sept. 8		18
" 2	Sept. 2 to Sept. 22		15
" 3	Aug. 29 to Sept. 26		40
" 4	Sept. 2		17



Oviposition among tree crickets: 1, Eggs of *quadripunctatus* Beutm.; 2, Eggs of *nigricornis* Walk.; 2a, In raspberry cane; 3, Eggs of *niveus* DeGeer; 3a, Punctures by *niveus* in apple bark; 3b, bark removed showing egg in position.

THE CABBAGE APHIS, APHIS BRASSICAE

By Glenn W. Herrick

Mr. J. W. Hungate, a graduate student in entomology at Cornell University, made a careful study of the habits and life history of the cabbage aphis during the late fall, winter, and spring of 1909 and 1910 under the direction of the author. Since Mr. Hungate left the work, the author has carried it on repeating the observations in large part. The life history of the aphis has now been followed nearly a year from the stem-mothers, and experiments in the control of the pest have been made during the past season. The results of these studies and experiments are here briefly given.

Economic Importance of This Insect

In 1890, 1903, and 1908 this aphid was very numerous, widespread and destructive in the state of New York. Moreover, our records show that we received more inquiries regarding the cabbage aphis during 1909 and 1910 than about any other insect pest. It was exceedingly abundant and seriously injurious in all parts of New York State during the season o' 1909 and appeared again in 1910, but did not prove nearly so injurious as last year. It not only destroys wide areas of cabbages, but many fields of cabbage were either entirely abandoned or plowed up early in the season of 1909 from a feeling of utter inability to check the pest. Some fields were plowed up in 1910 rather too early, for in most cases the parasites and predaceous enemies soon became abundant enough to hold the aphis in check.

Seasonal History of the Aphis

The oviparous females appear in the fall, are fertilized by the males, and deposit their eggs in large numbers on the leaves of the cabbage. The eggs were deposited freely during the month of October and first days of November. The first eggs were noted on October 10, 1909. No doubt some were deposited before this date. There seems to be no question but that the eggs are deposited on cabbages in great numbers and that a great majority of the eggs are fertile and hatch in the spring. Eggs were found on cabbage, rape, turnip, brussels sprouts and kohl-rabi, but in small numbers except on the cabbage. They were deposited in greatest numbers on the undersides of the cabbage leaves and were usually placed in depressions and crevices of the leaves. The egg, when first laid, is of a pale greenish yellow color, but usually soon turns dark and finally becomes almost black.

On eighteen leaves taken at random there was found to be an average of 62+ eggs on the upper sides and 115+ on the lower sides. On six leaves taken from a badly infested field there was an average of 293+ eggs to the leaf, the highest number on any one leaf being 343. Leaves bearing eggs were collected in the fall and kept outdoors under as natural conditions as possible to determine what per cent of the eggs would hatch. Under these conditions it was found that 76 per cent of them hatched when brought into the insectary in March. Whether all of the eggs thus collected were fertile or not we had no means of knowing. On the other hand, a known number of fertilized eggs were kept under natural conditions outdoors and all of these hatched the following spring. Eggs deposited on October 15 and 16 hatched in the field on March 30, thus giving five and one-half months as the period of incubation. The spring of 1910 was earlier than usual, however, and likely hatching occurred somewhat earlier than in ordinary seasons.

On April 1, 1910, the newly hatched stem-mothers were found present on the stumps of cabbage left standing in an infested field from the fall before. The field had been plowed; but many of the long stumps were left with their tops projecting and these had begun to send up new growths. In the centers of these new growths among the tender leaves, stem-mothers were found in abundance. The number was counted on five different plants and ran four, eleven, thirty-one, five and nine respectively. In another infested field not plowed, but in which the stumps had remained undisturbed, the aphids were found in varying numbers. From these stem-mothers we have reared up to the present time, December 3, 1910, twenty-one generations of agamic wingless females. The average length of each generation has been 11 4-5 days.

During the summer, generations of winged forms are produced, especially on crowded plants, and these serve to distribute the aphis to different plants.

Hibernation

In the warmer climate of the Southern States the cabbage aphis undoubtedly remains on the plants in the adult condition the season through. They have been observed all through the winter on cabbages at Agricultural College, Mississippi. In Florida, Quaintance says the mildness of the winter often allows the agamic females to carry the species through the year. It is doubtful if the adults can survive the winters of New York State.

Several plants infested with aphides were set beneath cages covered with cheese cloth and frequent observations made on the effect of the lowering temperatures. The insects throve and multiplied during

November when temperatures of 20° F. were not uncommon. By December activity had practically ceased and the aphides began to decrease in numbers. On January 4, with the temperature one degree below zero, a few were still alive but all of them succumbed during the night of the 4th, when the temperature fell to 5° below.

Reproductive Habits of the Agamic Forms

The stem-mothers molted at intervals of three or four days and matured in about fourteen days. They gave birth to young that developed into wingless agamic females. The average length of life of a stem-mother determined from the complete records of fourteen different individuals was 45.21 days. The maximum length of life was 50 days, the minimum 41 days. The average number of young produced by a stem-mother, determined from the records of the fourteen individuals, was 42.86. The maximum number was 53, the minimum 27.

From a record of many of the ordinary wingless agamic forms it was found that the average time required for maturing was 12.81 days, the average length of life 46.14 and the average number of young produced 41+. The highest number of young produced in one day was six.

The length of life of the winged forms is apparently much less than that of the wingless, at least this was true of those reared in the insectary. In no case did they live more than ten days after maturing, and some gave birth to as many as seven, eight, and thirteen young while some died without giving birth to any.

Reproductive Habits of the Sexual Females

The sexual forms were first observed October 10 and were in evidence until the latter part of November. In the case of four females whose times of pairing with the males were observed, eggs were deposited from twenty-four to twenty-six hours after fertilization. There is good evidence that some females oviposit without fertilization.

From the records of sixteen fertilized females we found the largest number of eggs deposited was five, the lowest one, with an average for the sixteen of 2.56 eggs. The intervals between the times of oviposition varied greatly. In some cases oviposition occurred at quite regular intervals while in other cases long intervals elapsed between periods of egg-laying.

Natural Enemies

The natural enemies of the cabbage aphis are numerous and in most seasons effective in holding this pest in check. The season of 1910 was especially favorable for these natural enemies and although the aphis promised in the early part of the season to become abundant, it was eventually controlled in most of the cabbage growing areas of New York State by its enemies.

The larvæ of several species of Syrphus flies have been observed to feed upon the aphides. These flies were especially abundant this year in a badly infested patch at Groton, N. Y. It was interesting to observe the flies depositing their long, oval, white eggs among the aphides. We have reared two species, *Sphærophoria cylindrica*, and *Allograpta obliqua*. In addition, *Syrphus americana* and *Syrphus ribesii* were seen to oviposit among the aphides.

The two lady-birds, *Adalia bipunctata* and *Hippodamia convergens* were exceedingly abundant this year and did tremendously effective work in destroying the aphides.

Xystus brassicæ and *Aphidius piceus* are the two most effective parasites. There were literally thousands upon thousands of aphides parasitized this season by these two insects, especially by the latter. Hundreds of Aphidius were bred from aphides brought from the field in the latter part of August. It seems to me that these two parasites and the two species of lady-birds already named, especially *Aphidius piceus* and *Hippodamia convergens*, are the most efficient natural means of control.

Other insects issuing from the boxes containing leaves of cabbage were *Asaphes rufipes* and *Pachyneuron micans*. Just how far these are true parasites or hyperparasites or both is not known to us.

Methods of Control

Clean Cultivation.—In consideration of the egg-laying habits and consequent production of stem-mothers on cabbage stumps in the spring of the year it must be admitted, it seems to me, that the disposal of all leaves and stumps is very desirable. They could be easily pulled, laid in the bottoms of the furrows and plowed under in the fall or winter. Simply plowing a field without pulling the stumps does not bury them, as was shown in a trial field during the spring of 1910.

The destruction of weeds, serving as food plants, in the vicinity of the fields should also be practiced.

Seed-Beds and Plants.—Inquiries are often received regarding the infestation of plants in the seed-beds and means of freeing the

plants before setting in the field. During the past season a series of experiments in dipping seed-bed plants in various solutions was carried out in response to these inquiries.

A home-made fish-oil soap after the following formula devised by Van Slyke and Urner was used with good results:

Caustic soda	6 lbs., or	1 1-2 lbs.
Water	1 1-2 gals., or	1 1-2 qts.
Fish-oil	22 lbs., or	5 1-2 lbs.

Simply dissolve the caustic soda in the water at ordinary temperature and when completely in solution add the fish-oil gradually, in the meantime stirring the mixture vigorously. Complete and thorough stirring while the oil is being slowly poured into the water and soda is absolutely necessary. This gives a fish-oil soap at ordinary temperatures that has no free alkali, is constant in water content, and a very effective contact insecticide.

Plants were dipped in solutions of this soap with the proportions of 1 to 8, 1 to 10, and 1 to 15. The solutions of 1 to 8 were entirely effective, killing every aphid hit. The weaker ones were not entirely effective.

No burning of the plants was induced so long as the plants were dipped singly. In a series of experiments in which many plants were dipped in bunches of dozens and half-dozens and allowed to lie until set out and in some cases allowed to lie a half-hour in the sun, burning was experienced in one case only. This was in the case of a bunch of plants that had lain one half-hour in the sun with the roots protected. The burning, however, affected only the outer leaves and the plants recuperated very quickly. In the case of those plants which were dipped in bunches some aphides always escaped being hit.

A similar series of experiments was carried out with Leggett's Anchor Brand of whale-oil soap. The solutions of 1 to 8 gave just as good results as like solutions of the fish-oil soap. The weaker solutions of 1 to 10 and 1 to 15 did not give as good results in killing the aphis as like solutions of the fish-oil soap. This, perhaps, shows a higher water content and consequent weaker solutions.

Plants were also dipped in Black Leaf tobacco extract at the rate of 1 to 100. All plants bore living aphides and no dead ones were found. No injury to leaves. When plants were dipped in Black Leaf 1 to 64 a few aphides were killed, but many were left alive. No injury to plants resulted.

These results should not be interpreted as showing that Black Leaf will not kill the cabbage louse. As a matter of fact it is a very effective killing agent for this pest when applied with force, as we have

demonstrated in laboratory and field experiments. In dipping plants, the solution simply runs off of the aphides and leaves without apparently having any caustic or killing effect whatever. If we had added a small amount of soap no doubt the extract would have stuck and done its work.

A series of plants dipped in solutions of lime-sulphur, 32.5° Beaumé, in the proportions of 1 to 40 and 1 to 30 were quite badly burned in every case and only a small per cent of aphides was killed. The tendency of the lime-sulphur to run off the leaves without apparently touching the aphides was almost as marked as in the case of the tobacco extract.

Spraying in the Field.—During the latter part of August we sprayed a very badly infested field of two acres. We used a knapsack sprayer. There were seventy-six rows (all about the same length) of cabbages in the field. We sprayed sixteen rows with Black Leaf extract 1 to 64 and used forty-eight gallons of mixture. The material was very effective; but it did not spread over the leaves readily and more material was necessary for a given area than of the fish-oil soap solution.

The remaining sixty rows were sprayed with the fish-oil soap solution at the rate of 1 to 6. The results were very encouraging. The material spread readily and killed all aphides hit. We used, on an average, 2 1-3 gallons to the row. At this rate, it would have cost to spray the two acres by hand, using fish-oil soap and counting cost of material and labor, about $2.15 per acre. In other field experiments equally good results were obtained with the proportions of 1 to 7. This would slightly lower the cost of spraying per acre.

I believe a cheaper and more effective method of spraying cabbages would be to mount a barrel with two leads of hose in a one-horse wagon and have a man on the ground at the end of each hose to direct the nozzle.

Whether cabbages can be sprayed with power sprayers effectively or not is a question upon which we need more definite information.

NOTES ON SOME INSECTS AFFECTING THE SUGAR CANE

By F. W. Urich, *Entomologist, Board of Agriculture, Trinidad*

The sugar cane has been cultivated in Trinidad for a long time and there are localities in which canes have been grown without interruption for quite a century. It, therefore, speaks very well indeed for the vigor and hardiness of canes that today there are not more cane pests to contend with than we have at present. It is true that many

changes have taken place, better varieties of canes are grown and the methods of cultivation leave nothing to be desired.

Besides the pests of old standing such as *Diatræa saccharalis*, *Sphenophorus sericeus* and *Rhynchophorus palmarum*, two insects, *Tomaspis postica* and *Castnia licus* have been more injurious than all the others put together. *Tomaspis postica* appears to have existed on cane in this island for a long time, but it was only in 1908 that these Cercopids were recognized as being the authors of a cane blight that caused considerable loss from time to time. From its original food plant, grass (several species) *T. postica* adapted itself so well to sugar cane that today a hard fight is taking place to eradicate it from sugar cane plantations. The life history of this insect has been fully worked out and some of the stages appear to be more vulnerable than others, but one of the chief difficulties in combating not only this insect, but many other insect pests in the tropics, is the continual succession of broods and continuous generation which take place. Only abnormal conditions of weather seem to exercise a slight check as far as *T. postica* is concerned, extremes of dry or wet weather keeping it down.

Contrary to the habits of some members of the Homoptera *T. postica* inserts its eggs by means of the ovipositor into the tissue of withering cane or grass sheaths instead of choosing green and growing tissues. The eggs are deposited singly, and take, in favorable weather, from twelve to twenty days to hatch. In very dry weather eggs do not hatch immediately and this would appear to be the only resting or æstivating stage of the insect. The young nymph makes its way to the ground, attaches itself to the nearest cane or grass root and surrounds itself with the spittle characteristic of the Cercopidæ. The nymphal stage lasts from thirty-two to forty-two days and during this time skins are shed four times, the cast skins remaining in the spittle mass.

When the final moult is about to take place, the nymph ascends a foot or two on a grass stalk or cane and in a kind of hollowed-out chamber in the froth undergoes the final moult. The newly issued adult remains in the chamber until quite strong and fully colored, a process requiring several hours. The proportion of males and females in the fields varies according to season, but on an average 51 per cent of the total number are males. Each female is capable of laying thirty to forty eggs. *T. postica* in its nymphal stage appears to be so well protected that no natural insect enemies have been observed, the only natural control that has been found to be of some use is a parasitical fungus, which attacks both adults and nymphs, but mostly the former. Mr. J. B. Rorer has identified this fungus as *Metarrhizium anisopliæ* Metschnikoff. Experiments with the fungus conducted on a small scale have given

such good results that it will be used on a large scale in rainy weather, the time most favorable for its growth and also the time when *T. postica* is more numerous.

Castnia licus is the other cane pest of importance, but up to now no weak stage in its life history has been discovered which would facilitate its control. The only method of dealing with it has been by gangs of boys catching adults. Some good has been done, however, for in 1909 for a period of nine months 144,606 moths were caught on one plantation and in 1910 for the same period 72,645. About 60 per cent of the total number caught are males. Each female is capable of laying from 100 to 150 eggs. Broods overlap each other and it is possible to get all stages of the moth during every month of the year. The caterpillar appears to live more in the root stocks of the canes, only tunneling up cane stalks for the purpose of feeding. The time a caterpillar takes to develop varies a great deal and depends entirely upon the nature and quantity of the food. In connection with an experiment now in progress, a caterpillar fed with sour cane has taken three months to attain what appears to be one half its full size.

Of the other cane pests, *Sphenophorus sericeus* and *Rhynchophorus palmarum* deserve some attention. These beetles are always present on sugar cane plantations and should the canes turn sour from any cause, they are certain to be attacked by one or the other or very often by both. Both are more injurious to plant canes that have not been properly treated with a fungicide before planting. The struggle for existence which goes on in a piece of cane about twelve inches long is remarkable. As a rule it will attract *S. sericeus* first, then *Xyleborus perforans* is sure to follow. These two species live together in apparent harmony and quite a number of *S. sericeus* will issue from a single cane plant. When, however, a *R. palmarum* deposits two or three eggs in a plant, things change considerably and before the palm weevil is half grown, there is only one of its larvæ to be found in each plant. Whether accidentally or intentionally, any other grub is destroyed and possibly devoured. It is a bitter struggle for existence and only one *R. palmarum* survives. The larva of each species has its characteristic way of burrowing. *Sphenophorus* works immediately under the rind of the cane and makes its tunnels outwards gradually going to the centre as the food supply is finished. *R. palmarum* bores through longitudinally up and down in any fashion and when its development is nearly completed, a cane plant is but a mass of frass enclosed in a thin shell of rind in which the larva pupates.

There are also two small borers attacking canes *Diatræa saccharalis* and *Diatræa canella*. The former seems to thrive just as well on a tall grass growing in the cane traces as on cane and the latter is generally

found on cane. Although put down as second-rate pests, a careful investigation would reveal the fact that they are not altogether to be neglected.

HABITS OF THE HONEYSUCKLE APHIS, RHOPALOSIPHUM XYLOSTEI

By MARY E. MURTFELDT, *Kirkwood, Mo.*

No species of aphis with which I have had experience—except, perhaps, the Grape Phylloxera on non-resistant varieties—has been found so persistently destructive and so almost impossible of control as the one named above. This appeared ten or twelve years ago in the gardens in and around St. Louis and on the wild vines growing in the open woods along the Merame river. It does not attack all varieties of these twining shrubs, but seems to find in the structure of the Sweet Dutch and Italian, as well as in that of the native Coral or Trumpet species, *Lonicera sempervirens*, also in cultivation everywhere—just the conditions suited to its development. The peculiarity of these species is that they bloom only on the tips of the new shoots, the blossom clusters being subtended and at first closely enfolded by a pair of bract-like leaves. Now, as the aphis colonies feed and multiply only on the flower buds and blossoms throughout the spring and early autumn, these bracts afford them shelter and concealment and their innumerable punctures cause the leafy valves to close more and more tightly over them and over the retarded buds, so that they are in a great measure protected from parasitic and predaceous insect foes and also from all dustings and sprayings with insecticides, unless these are applied with great force. Even smoking with tobacco stems under a large dry-goods box or under a canvas tent failed to suffocate them.

So far as I have been able to ascertain this aphis hibernates in the agamic, "stem-mother" form, concealed under leaf buds or protected by such scanty, withered foliage as remains on the vines. But I must confess that assiduous search has brought to notice but few of these. A very few eggs have also been found, late in autumn, generally in pairs on the tips of leaf buds. They are scarcely visible to the unaided eye, being not more than 0.2mm. in length, of oblong form, brownish black color and, so far as could be revealed under a strong lens, with a smooth surface. I have not been able to differentiate the sexes, not having made microscopic studies of the forms, but infer that true males and females are developed in small numbers late in the season as the eggs would indicate.

With the earliest setting of the blossom clusters in spring, the aphides are also found to be present and these continue to multiply and spread over the vines, so that rarely any blossom clusters perfect throughout the spring and early summer.

About the first of July the insects almost wholly disappear and the vines have a respite from their attacks and are enabled to develop a scant crop of blossoms and to make a little annual growth, but by the latter part of September the pests are again in evidence in full force and scarce a flower cluster escapes injury, if not complete destruction.

The aphides continue to multiply until the first hard frost, which wilts the protecting leaves and causes the pests to disperse over the stems and foliage and it is at this time that the winged forms seem to be most abundant.

The species of honeysuckles so devastated include the choicest varieties,—all that have smooth, somewhat glaucous foliage and bloom from their growing points continuously throughout the growing season.

The European varieties produce profuse clusters of delicately colored broad trumpet shaped blossoms, which diffuse, during the early morning and evening hours a perfume of most exquisite and refined sweetness, which is withheld under the heat and brilliance of the noonday sun. Our native *sempervirens*, though scentless, was formerly one of our most vigorous and valued climbers, whose blossoms, bright red externally and soft orange within, rendered it by far the most showy of all the species.

Previous to the advent of the aphis—from whence it is difficult to conclude—all these vines were rapid growers and most desirable for shading piazzas and for trellis ornamentation. Now they only survive in the form of half-naked stems and low deformed bushes, with little of their natural habit and attraction. I have not attempted any structural description of the insect, as Professor Gillette, who very kindly made the determination for me, wrote that he would have a paper on the subject for the meeting of the Entomological Association.

I may mention further that I have never found ants attending this species and rarely, before the past summer, were lady-birds seen among the colonies, but this year the winter lady-bird *Adalia bipunctata* and its larvæ were found feeding upon a large proportion of the spring colonies and, later in the season, the latter were preyed upon to a considerable extent by the larvæ of one or more Syrphus flies from which, as yet, I have not been able to obtain the adults.

In these and possibly other natural enemies we find some ground for hope that this pestilent despoiler may be so kept in subjection, that our favorite climbers may once more display their pristine loveliness.

WHY COLLECT INSECTS?

By MARY E. MURTFELDT, *Kirkwood, Mo.*

One reason. With all the excellent and profusely illustrated Manuals of Entomology, with Doctor Holland's exquisite Butterfly and Moth Books and Doctor Howard's inclusive Insect Book and innumerable monographs, bulletins and reports on injurious and beneficial insects, it seems scarcely worth while for the amateur entomologist or the teacher, to be at the trouble and expense of making a collection of specimens. But for some reason the most accurate and attractively colored pictures fail of making an impression on the youthful mind, at least. They are so satiated with depictive art in newspapers and magazines, so much of which is caricature or exaggeration, that they have become sceptical as to the honesty of any representation which they cannot personally verify.

The teacher of agriculture in our high school this autumn, on coming to the subject of "Injurious and Beneficial Insects," applied to me for the loan of a case of specimens representative of the principal orders and especially of species of economic importance, saying that the youths were indifferent to the pictures shown in illustration of the lessons or objected to them as works of imagination—particularly the boys balked at the cut of *Thalessa lunator*, as given in Professor Smith's "Economic Entomology."

"Aw! you can't tell me that there is any such fly as that! How could it manage to get those boring threads into the heartwood of a tree?" said one.

So happening to have a good specimen of the parasite, I included it among those prepared for the school and great was the wonder and interest excited by a veritable example of the supposedly impossible species.

For several days, as I was afterwards told, that case of insects was the chief attraction in the building to both teachers and pupils and to a number of those not connected with the school, who wondered how it had been possible to collect so many lovely butterflies and moths, brilliant and grotesque beetles and other curious and attractive forms in the immediate locality in which they had lived for years—some of them all their lives—without ever having obtained a glimpse of them.

Needless to say that, after this, the lessons on entomology were not lacking in interest for either teacher or scholars and a most enthusiastic collecting fancy developed, which led to frequent consultations of the text-books for names and further knowledge of

habits, localities, etc., so that by the end of the quarter almost every member of the class had acquired a fair introduction to the science and had an intelligent appreciation of its importance as related to agriculture.

LIFE HISTORY OF THE RICE WEEVIL (CALANDRA ORYZA L.) IN ALABAMA

By W. E. Hinds and W. F. Turner

An examination of the literature relating to this species shows that our really definite information as to its life history is very scanty indeed. Only scattered and incidental references to isolated facts have been recorded in spite of its great economic importance. One reason for this is, doubtless, that the injury done by this insect is greatest in those sections of the country where economic entomology is but a comparatively new study. Another reason may be that its work has been confused with that of its close relative *C. granaria.*

In the United States, certainly, *Calandra oryza* is the far more important species of the two and here its injury seems to be of greatest importance in the Gulf and South Atlantic States especially. This is primarily on account of the milder winters and the longer season of activity during the fall when they may multiply most rapidly. The injury done by this species would seem to be one of the factors which has restricted the raising of corn and the production of livestock and tended to promote the "one-crop" system of cotton culture which has generally prevailed for a generation past. With the advance of the Mexican cotton boll weevil (*Anthonomus grandis* Boh.) the rice weevil becomes of increasing importance since the plan of fighting the boll weevil involves, as a rule, the production of more corn and the storage of the crop until it can be fed out to livestock. The rapid depreciation of stored corn has retarded the general adoption of this practice.

In this paper we can attempt to give only a general statement of the results of observations which have been accumulating in this office during the past two or three years. But we believe that much of the data will be welcomed by other workers, especially by those in the South. We cannot attempt to record any results of experiments looking to the control of the pest, but shall record the facts of life history in more detail than would appeal to the average farmer for whom a bulletin may later be issued.

The stages of the insect may be first considered:

The Egg.—The egg of the rice weevil is always deposited within the kernel of some grain. It is regularly elliptical or sometimes rather

"pear-shaped," with the larger end outward as it rests in the grain (Pl. 7, fig. 2). The covering membranes are thin and of an opaque white color. The average length of eggs is about 0.665 mm. by about 0.295 mm. thickness at the larger part. The young larva can be seen through the egg covering shortly before it is ready to hatch. Hatching occurs in an average of three days from deposition of the egg with a mean temperature of between 60° and 65° F. There appears to be a considerable mortality during the egg stage as not nearly as many larvæ develop in corn as there are eggs deposited, but the exact proportions have not been determined. It appears to be fully 50 per cent, however.

The Larva.—This stage has been figured by a few writers. Photographs are here shown of the young larva as it hatches from the egg and also of the fully grown larva (Pl. 7, figs. 3, 5). The grub is of a creamy white color except the head which is brownish shading to nearly black at the tips of the mouth-parts. It is very thick bodied, with the ventral line approximately straight while the dorsum is almost semi-circular. There are three larval stages as shown distinctly by the measurements of heads. In the first stage the head averages approximately 0.22 mm. in breadth at its widest part; in the second stage, 0.33 mm. and in the third stage 0.64 mm. The first larval stage requires about three days, the second four days and the third nine days on the average, with mean temperatures of between 60° and 65°F. There is then a distinct prepupal stage in which the forming pupa is plainly visible through the unshed larval skin lasting for usually one day. The entire larval stage, therefore, requires between sixteen and seventeen days on the average, with a common range of between fifteen and nineteen days under usual temperature conditions. The pupal cell is always formed within the kernel and may be either in the heart of the kernel or near its exterior.

The Pupa.—This instar is somewhat longer and more slender than was the grub before it (Pl. 7, fig. 6). There seems to be considerable variation in length of this stage at the same period, with the average at about six days and the range between three and nine days. Considerable brown coloration appears before the pupal skin is shed. After the insect has become adult it still remains within the kernel for several days to harden and fully mature before it makes any attempt to escape.

Naturally, with all of the immature instars, the duration of the stage is very largely determined by prevailing temperature conditions. The records that have been given relate to observations ranging from about the middle of August to the early part of November in the latitude of Auburn, Ala. The breeding of weevils continues more or less

steadily throughout the winter provided the temperature remains sufficiently high. The occurrence of a particularly cold snap, as when temperature falls to below 10° above zero, while it does not exterminate the weevils, still appears to destroy a large part of the immature stages and many adults and thus greatly retards subsequent multiplication and injury by the pest later in the winter. As a rule the greatest damage by these weevils is done before the end of December, in this State, and thereafter to corn that is stored beyond the following April.

During the winter season, as from December 15 to March 15 the larval stage has been known to be extended to beyond 115 days, or about four months, in spite of the fact that the infested corn was kept in a heated building where the day temperature averaged nearly 60° with the night temperature probably 10° to 15° lower.

The Adult.—As has been said, the adult remains in the pupal cell for several days, usually three to four, for hardening and maturing before it starts to cut its way out of the kernel. Much feeding may then be done within the kernel without any attempt at emergence, so that we cannot reckon the life-cycle from observations based solely upon the time between oviposition and the emergence of the adult. Many weevils perish in their effort to escape from the kernel, being found wedged in the exit hole, usually with only the head, prothorax and forelegs free.

At an average temperature of about 63°, development from oviposition to the emergence of the adult may take place in about thirty-two days. The general average, however, is rather longer than this and for the first field generation, appears to be about six weeks and for the second field generation between seven and eight weeks. This is between about the first week of August and the last of October.

The adult rice weevil, or "black weevil," as it is often called in the South, is a rather slender, cylindrical beetle, averaging in length of body from the front margin of the prothorax to the tip of the body, about 3.5 mm. and for the length of head and snout about 1.6 mm. The normal color is a very dark brown or nearly black and is uniform except for four reddish spots located one at each corner of the wing-covers. The prothorax is densely and uniformly punctured as are the elytra (Pl. 7, fig. 1). The reddish spots and the punctation serve to distinguish this species from *C. granaria*. The average weight per weevil is approximately 0.003 gram, or more than 150,000 weevils per pound.

Distinguishing the Sexes.—This is not a difficult matter, although size and color do not appear to indicate it at all. In size, measurements of 20 females shows a body length averaging 3.5 mm. and a head and snout length averaging 1.66 mm. Among 20 males, the body length

was 3.5 mm. and head and snout 1.55 mm. This shows that females average no larger in body, but have distinctly longer snouts than do males. Under the microscope or a good hand lens, there is little difficulty in separating the sexes solely upon the appearance of the snout. The male snout is plainly thicker and more deeply punctate than is that of the female.

The two sexes are produced in approximately equal numbers. On stored corn, however, many more males than females are likely to be found outside of the kernels while a larger proportion of the females are engaged in feeding on the inside of those kernels which show weevil emergence holes.

Spring Activity.—It is certain that many weevils hibernate in the fields. Large numbers were found in the course of the boll weevil investigations hibernating both in empty cotton bolls and more frequently in old corn stalks. They have been found moving in the field as early as February in Texas after a very mild winter, and as early as January 30 in Alabama Of course large numbers occur around corn cribs. It is evident, however, that in the field the rice weevil must have some other food than corn grain to survive the long season during which this is developing. What is this food normally? Of this we are not yet certain as observations are only scattering. Weevil adults are to be found in many locations before corn is ready for their attack, but their occurrence may not indicate that they are feeding there. We have no record of breeding occurring except on some grain and during the fall of the year in the open field.

Dissemination.—The possession of functional wings is another character in which this species differs from the "granary weevil" and it is very certain that it spreads in the field entirely by flight. They do not even crawl up the corn stalk to reach the ear but fly directly thereto. We do not know how far they may spread from field to field but it is certain that corn raised for the first time on ground at least a mile from where corn was grown the preceding season is certain to become infested before it is ready to harvest. Our observations indicate that the season of greatest activity in flight is coincident with the maturing season for corn. Early corn serves to concentrate most of the weevils in the neighborhood and by presenting conditions favorable for the breeding of the weevils through so much longer time, it is ordinarily much more seriously injured by the weevils than is late maturing corn.

First Attack on Corn.—Rice weevils do not seem to be able to feed on any part of the corn plant except the grain. Weevils placed on young growing corn starved to death with no evidence of feeding. Weevils placed on corn in the milk stage fed somewhat and life was prolonged

to about twice the starvation period at that season but there was no evidence of breeding on this corn. All observations show that the attack on corn does not begin until it has reached the "dough" stage. At this time the husk is drying and shrinking, so that it is also easier for the weevils to gain access to the kernels. In the South the "cotton boll worm" or "roasting ear worm," *Heliothis obsoleta* Fabr., is so abundant that very few ears indeed escape some injury from their attack and it is very noticeable that weevil injury is greater on ears which have been badly injured by those worms. They leave the door wide open for the entrance of weevils later on. The length and tightness of the corn shuck is a very important factor affecting the severity of early weevil injury.

Duration of Life Without Food.—Observations ranging from early spring to late fall show that these weevils cannot live long without food. In April the average was about nine days and in May only five days for the starvation period, while in August the average was seven days.

Duration of Life With Food.—Our breeding work has all been done with corn, although the weevil is reported as attacking other grains also. It seems that the adults cannot feed upon isolated kernels of fully matured hard corn as in all cases they died in the usual starvation period with no signs of feeding when so confined. Where feeding can take place normally, the length of life is exceedingly variable, extending in many cases, where the winter season intervenes, to six or eight months. Males live longer than do females as a rule.

It is interesting to note that the only positive observations as to these weevils feeding in the field before corn matures shows that they attack immature fruit of peach and apple, sucking the juice and gradually forming cavities within which they may be entirely concealed and even present a real burrowing habit (Pl. 7, fig. 7). On such fruits weevils have been kept alive for more than six weeks in spite of a decayed condition of the fruit.

Mating and Reproduction.—Rice weevils are both polygamous and polyandrous. Mating may occur with both sexes within twenty-four hours of their emergence from the grain. Some feeding may have occurred in the grain and also in making their exit holes. A period of about three days then ensues before females are ready to begin oviposition. Subsequent matings are common and in laboratory breeding experiments it is evident that mating frequently results in more frequent oviposition, especially after a large number of eggs has been deposited.

Oviposition.—This occurs normally on corn at a spot that may be called an "outer angle" of the kernel. Kernels at the tip are usually

first infested and later those near the butt of the ear. The female eats out a cavity large enough for the egg, occupying usually about forty-five minutes in the operation when the corn is fairly hardened, then turns, locates the cavity with the tip of the abdomen and inserts the fleshy ovipositor. The deposition of the egg requires only about three minutes and the cavity is then sealed over as the ovipositor is withdrawn. The top of the egg is just below the surface of the grain. The female will then rest for a short period before starting another cavity. Conditions are most favorable for both the adult and the young when eggs are deposited in corn which has just passed the "dough" stage. In this condition the grain can be cut with the thumbnail and may be characterized as a "hard gum" stage. All corns, no matter how hard they may become later, must pass through this stage during which they are subject to attack if weevils have access to the kernels. Long, close-fitting shucks may serve to so retard weevil entrance that the grain may harden and become more resistant to subsequent injury.

Rate of Oviposition.—This is a point upon which we have had no previous data. It has been interesting to find out the factors affecting the rate of egg deposition. Most important of these is evidently the degree of hardness of the kernel. With corn in the "gum" stage, the maximum record obtained was twenty eggs in twenty-four hours. Daily records of fifteen or sixteen eggs were not uncommon, while the average through a period of several weeks, with a number of weevils, was about seven eggs per day. Weevils which were laying ten or twelve eggs per day on "gum corn" would be checked to two or three eggs per day on hard corn.

The period of oviposition is nearly as long as the life of the female, beginning within a few days of her emergence from the grain. Eggs may be deposited until within a few days of death. The maximum oviposition period yet found is 110 days, but this female is still active at this writing. During this period 417 eggs have been deposited. Still another weevil deposited 374 eggs in the laboratory in addition to what she may have deposited in the fields before she was captured. The maximum record, however, includes the entire deposit as the weevil was bred.

Life Cycle and Generations.—The average duration of the life cycle during August and September is between seven and eight weeks. Generations, therefore, become wholly mixed within a short time. It appears, though, that about three generations are developed on early maturing corn before the middle of December and two generations with medium late corn. Infested corn, which has been kept in receptacles in the laboratory has shown but two generations for the

entire season and it is evident from the length of life occasionally found that a single generation might span the entire season.

Mortality.—This appears to be greatest during the coldest part of the winter season, when large numbers of the adults, as well as many of the immature stages, die. Accordingly, in March, after an average winter in this locality, but 14 per cent of either immature stages or adults were found alive.

In the field, during the fall, largest mortality appears to be with eggs and young larvæ. There is also considerable mortality during the prepupal stage and with adults in the act of emergence.

Parasites are not uncommon and two or three species have been bred from immature stages of the weevil.

Parthenogenesis:—It is interesting to note that we have found strong evidence of the common occurrence of parthenogenesis among rice weevils. Unfertilized females deposit eggs occasionally but much more rarely than is normal. Many observations have shown that these eggs may hatch. We have bred a male and a female weevil from eggs deposited by a positively unfertilized female. Their development required about five months, from October to March, in a heated room.

INJURIOUS INSECTS OF 1910 AT TREESBANK, MANITOBA

By Norman Criddle

The areas covered by this paper contains most of the types of soil found within the Province of Manitoba and a fair percentage of the kind of crops grown. It also embraces open country and woodlands of different sorts, so that, on the whole, we might expect to find within its borders most of the insect pests that inhabit other portions.

Owing to an exceptionally dry season cereal crops were, generally speaking, very poor and this made the inroads of some insects, notably grasshoppers, much more difficult to control than they would otherwise have been; it also caused several pests of importance to be overlooked, the poor condition of grain being generally put down to unfavorable weather conditions.

Insects Injurious to Grain and Grasses

Hessian Fly, *Mayetiola destructor*. — Injury was reported to be rather extensive in some localities but investigation did not bear out the reports, but revealed that most of it was due to other insects.

The Greater Wheat-Stem Maggot, *Meromyza americana*.—This and probably the Lesser Wheat-Stem Maggot (*Oscinis carbonaria*)

are responsible for most of the injury to young wheat that is noticeable almost every spring and put down to other causes, such as Hessian fly, wire worms, rot, etc. The attack is recognizable by a patchy appearance of the growing grain; odd plants, or more often several in succession may be seen to have wilted away. Examination will show that plants look as if they had been pinched about an inch below the ground, or to have rotted at that point; while a careful search usually reveals one or more whitish or greenish maggots which are very small at that time. About a month later, as wheat shows signs of heading out, there is another generation which causes the well known "White heads."

During the present year injury to young wheat was not as extensive as in 1909, though probably at least 1 per cent of young plants were killed. In July adults of *M. americana* could be swept up in fair numbers from grain fields and many stems of wheat were infested with larvæ. I note that this insect seems to be very partial to couch grass—*Agropyron repens* and *A. occidentale*. On a patch of the latter flies were collected weekly from May 6 until September 21.

Western Wheat-Stem Sawfly, *Cephus occidentalis.*—This is an insect that usually confines itself to native grasses upon which it subsisted entirely before the introduction of grain; its food plants being species of the genus *Agropyron*—especially *A. caninum.* Happily *A. tenerum,* which is now so extensively grown in western Canada, has proved almost immune, due, no doubt, to its more slender stems. This sawfly, however, readily adapts itself to new conditions and having once become established, seems to have a preference for the plants that it fed upon in its early stages. In 1906 owing to a failure of its native food plant to produce heads, it swarmed to the wheat fields, where it soon became established and, in some cases, where proper precautions were not taken, remained ever since. As there are still some details lacking in the published accounts of its habits, it may not be out of place to give a more detailed account of its life history.

The flies appear on an average about June 15, when they can be observed, resting head downwards, upon stems of grain and grasses. They deposit their eggs towards the end of the month at the time wheat is showing indications of—or is—heading out. The operation has not been observed, but doubtless the eggs are laid singly in the stem near the head by aid of the short ovipositor. The egg hatches within a few days and the larva commences to work its way downwards by eating out the inner tissues, and reaches the ground about the first of August. It then gnaws a ring around inside, causing the stem to fall down, then makes a chamber of the stub by covering the surface

and lining it inside with a silky water-tight substance exuded from the mouth. In this retreat it passes the winter—turns to a pupa late the following May and appears as a perfect fly in June.

The chief injury is due to the breaking down of wheat stems during winds and to their being cut through when the insect enters the ground.

The principle remedy lies in banishing the insect from cultivated ground as it will then only appear when its native food plants fail to produce heads.

Experiments with a view to discovering what depth of covering the fly could make its way through, proved that four inches of earth, when packed, was sufficient to prevent this, but that six inches were required when the earth remained loose. In working their way out at this depth, the flies are unable to keep a perpendicular direction and gradually turn over backwards making, if they live long enough, a complete circle. They seldom survived, however, a sufficient time to accomplish this, dying within fifteen hours.

Taking into consideration its life history the following remedies were tried and proved effective:

(1) Plough all infested stubble land before June 15, not less than four inches deep, to be afterwards packed, or six inches deep without packing.

(2) Cut all infested grass, between July 10 and August 1. This will catch the larvæ in the stems before they reach the ground. Burning infested stubbles or grasses in order to destroy larvæ while hibernating is absolutely valueless as all larvæ remain well out of reach below the ground.

The injury to growing grain during 1910 was not as extensive as it was the previous year, though in some places on odd fields it probably exceeded 2 per cent.

Wire Worms, *Corymbites æripennis* Kby.—Slightly injurious to grain crops in spring and later to potatoes.

Grasshoppers or Locusts.—These insects became very abundant during the season and did some injury to cereal crops in spite of the repressive measures adopted. Fortunately a backward spring delayed their appearance, so that all vegetation became well advanced before they commenced to attack it. The chief damage was done after locusts commenced to fly, as it then became a costly and difficult matter to spread poison bait over such an extended area, especially as the remuneration—due to bad crops—was not great. The "Criddle Mixture" again proved far superior to anything else, after locusts had once hatched, and in the Aweme district where it had to be applied frequently, it caused great destruction among the insects and unquestionably saved

many crops. The successful application of this mixture is largely due to weather conditions. Firstly, the day chosen for spreading it should be sunny with the temperature above 60° F. in the shade. Secondly, dry conditions will always prove advantageous and bring greater results than wet, as then the mixture will be attractive on account of the moisture it contains, apart from any other attraction. Indeed, on hot, dry days locusts will often travel some distance towards a receptacle containing water. Thirdly, it is advantageous to spread poison during the warmest part of the day, as it is then that grasshoppers are most easily enticed towards it.

An examination reveals many egg masses present on stubble and other suitable land, so that under ordinary conditions another outbreak of greater severity may be expected in 1911.

Several parasites were present. Firstly, a Tachina fly caused many deaths during July and then three species of blister beetles were present in unusual numbers, namely *Contharis nuttalli*, *Epicauta pennsylvanica* and *E. sericea*. The first two subsist largely upon members of the pea family though the second did some injury to potatoes and beans. The last appears to confine itself to lamb's quarters.

An extensive migration commenced among locusts late in July and continued, when the weather permitted, until the 16th of August. The days chosen were hot and sunny with a moderate breeze. Looking up towards the sun with sufficient shelter to hide its disc, revealed a continual swarm passing by with the wind from a few feet above the ground to as high as sight could detect the glistening wings when passing near the sun.

Injury was also caused by eating through twine used to bind sheaves, in some places fully 70 per cent being cut through. Soaking balls of twine in two pounds of copper sulphate to ten gallons of water proved a perfect preventive, though it has a tendency to rot the twine and cause trouble when binding. If dried very quickly, however, this is partly avoided.

Locusts responsible for most of the injury done were, *Melanoplus atlanis*, *packardii*, *angustipennis*, *bivittatus*, *extremus* and *dawsoni*, in the order named.

Insects Injurious to Roots and Vegetables

Imported Cabbage Worm, *Pontia rapæ.*—Much less injurious than last year and did comparatively little injury.

Colorado Potato Beetle, *Leptinotarsa decimlineata.*—We experienced the worst outbreak on record of this insect. No potato patch was free from it anywhere.

The Manitoba beetles are considerably later in making their appearance than farther east and south. Here the first are generally noticed about June 15, at the time when potatoes are just making their way through the ground. In 1910 the first larvæ were observed June 13, and these reached the adult state July 16, and became sexually mature towards the end of the month. On August 8 some of these commenced depositing eggs and larvæ were noted a few days later. A few of these pupated the second week in September, but no beetles appeared from them, and their condition late in October left little doubt that most, if not all, of them would perish during the winter.

Successive applications of Paris green proved perfectly satisfactory.

There was also a remarkable outbreak of June beetles, in the larval state. One species—*Lachnosterna fusca*—was so plentiful that it caused the total destruction of large patches of native grasses, in some instances covering an area of half an acre or more. These were well up on the grass land, while another species did some injury to potatoes in moist situations.

Trees and shrubs also suffered from the ravages of several insects during the year, of which the following were the most important:

The Willow-leaf Beetle, *Galerucella decora.*—Overwintering beetles appeared in swarms as soon as willows commenced to form leaves and in the course of a month had almost defoliated most of these shrubs, after which they vanished, being very severely attacked by a red mite and doubtless by other parasites.

This beetle appears every few years and occasionally is the cause of much injury to aspen poplars (*P. tremuloides*), apart from completely skeletonizing several species of willow. The chief damage to aspens is when they commence to leaf out before the willows or later in the season when the latter, through defoliation, are no longer available for food. The larvæ seem to be entirely confined to species of Salix. There is but one brood in a season.

The Aspen-poplar-leaf Beetle, *Lina tremulæ.*—This is another pest that kills many young trees every eight or ten years, besides making aspen bluffs almost uninhabitable at certain seasons, owing to the very disagreeable odor of the larvæ. The species is gradually increasing and may be expected to become very injurious again within the next two years.

Pepper-grass Beetle, *Galeruca externa.*— Were in very large numbers in places where their favorite food plant (*Lepidium*) was prevalent, and in consequence did much good. Years when this plant fails however, they are apt to attack other cruciferous plants and have been known to extensively injure young turnip and cabbage plants.

Several pests of lesser importance occurred during the year. Currants suffered rather extensively from currant Sawflies. Cattle were much annoyed by Horn flies which were more numerous than ever before in Manitoba, in spite of a very dry season. Stable flies also appeared in greater numbers than usual, while several species of *Tabanus* were unusually prevalent in July. House flies seemed to invade the whole country, not even the prairie far removed from dwellings being free from them.

THE COTTON SQUARE-WEEVIL OF PERU AND ITS BEARING ON THE BOLL-WEEVIL PROBLEM IN NORTH AMERICA

By Charles H. T. Townsend, *Piura, Peru*

The year 1864 witnessed the first modern planting of cotton in northern Peru. Several years of civil war in the United States had so shortened the world's cotton supply that promise of great profit was held out to the Peruvian planter. This, therefore, was the reason for the beginning of cotton cultivation on a large scale in the Department of Piura, which now produces and has produced for many years one of the very finest qualities of cotton fiber in the world.

The first year's cultivation seems to have developed no noticeable plague. The following year a considerable area near the Andean foothills was planted to cotton. This region is cooler and moister during the summer than are the Piura and Chira river valleys, where the planting of the previous year had been done. In this foothill region there was observed at that time a condition which has ever since been known in Peru as the "hielo" of cotton. Its chief symptom is the falling of the squares before the flower opens. It was considered to be due to cold, whence the name, the word "hielo" literally meaning ice.

While the temperature in this region, from coast to foothills, never falls below 50° or 60° F., yet in the lower valleys the nights in July and August become very cold by comparison with the summer heat of January to March. The humidity is also greater in the former months, in fact, from May or June to October or November.

The falling of the squares was so serious in the above-mentioned foothill area as to cause the abandonment of cotton culture there later on. During the forty-five years that have elapsed since then, the so-called hielo has caused more or less serious damage to the cotton crop throughout the Department of Piura, as well as in other parts

of Peru, but practically only through the winter months from July to September, or June to October, the period of greatest cold and humidity. All causes have thus conspired to lay the blame for this damage to low temperatures at night followed by hot sun the next day, causing the squares to yellow, wither and drop to the ground or remain dried upon the plants. It is estimated in Peru that the effects of hielo have resulted in more damage to the cotton crop than all other causes combined.

During the past year the writer discovered the presence in the squares of cotton in the Piura and Chira districts of a limited number of weevils appearing like a minature boll-weevil. It was at once recognized as a species of Anthonomus distinct from the boll-weevil, but exceedingly like it to all appearances except in size. Specimens were sent to Dr. L. O. Howard, chief of the Bureau of Entomology in Washington, who replied that Mr. E. A. Schwarz pronounced them an undescribed species of Anthonomus, quite different from *A. grandis*.

A later letter from Doctor Howard statesthat Mr. Schwarz had gone over all the literature and finds that there has been only one species of Anthonomus described from the present region or its vicinity—this species is *A. vestitus* Boheman, described from the Island of Puna, in the Bay of Guayaquil, Ecuador; and, while the description agrees fairly well with the specimens of the square-weevil sent, nothing certain can be said about their real identity. The letter adds: "The trouble is that your Anthonomus, while radically different from our cotton boll-weevil, belongs to the least marked and least interesting group of the genus, where positive identification can only be obtained by comparison with the type. Moreover, it is well known that the localities in the work where Boheman described his *A. vestitus* got considerably mixed up."

This weevil is, to all causal intents and purposes, an exact minature of the boll-weevil, being about one third to one fourth the size of the latter. It works in exactly the same manner on the squares, feeding in them and depositing its eggs therein. Its small size, however, allows a remarkable number of weevils to develop in one square. I have taken as many as six adult weevils from one small square, all of which had developed to maturity therein. Numerous weevils were reared from both dried and green squares, both hanging and fallen squares; numerous grubs were found in the same, and reared to maturity. The weevil was found to occur commonly and generally, but in limited numbers, throughout the cotton districts of Piura Department during September and October; and further investigation develops its presence as almost certain throughout the cotton regions of western Peru and Ecuador. It is not known certainly to be present

in the moñtana on the east slope of the Andes, but facts point to the probability of its presence there. After careful study of the matter and comparison of the conditions in each case, it seems evident that the symptoms of the hielo and the effects and habits of the weevil are quite coincident throughout; and therefore that this damage which has been generally mistaken during the last forty-five years in Peru for the effects of cold and humidity, followed by heat, is in reality due to a close relative of the boll-weevil, working in the same manner as the latter.

A few persons had maintained the belief that the hielo was due to some insect or other animal organism, but no one had succeeded in finding the culprit. During the year 1910, in September of which I first discovered the weevil, the damage has been much lighter than usual, few of the weevils probably being present as compared with former years.

It was ascertained that about twenty-three days elapse from egg to adult during September and October. This time is doubtless shortened in November and December, until the hot weather of January puts an effectual stop to further breeding and causes the weevil to seek æstivating quarters. During the colder weather of July and August the life-cycle period is probably fully four weeks.

The adult weevils vary in length from 2.25 to 3.5 mm., and in width from .75 to 1.5 mm. On first issuing they are distinctly yellowish in color, but become grayish or darker with age. There is a patch of darker shade at the junction of the bases of elytra, due to fainter pubescence, and a less distinct one on each of the elytra posteriorly, producing the effect of a faint pattern.

Search during September and October, for weevils feeding and ovipositing in the squares, gave an average everywhere in the cotton region of Piura Department of one weevil to about twenty or twenty-five squares. Yellowed and dried hanging squares and fallen squares collected in the field gave a high percentage of infestation, which has not yet been computed but will doubtless average eighty per cent or more.

Two species of parasites have been reared in considerable numbers from the weevil grubs in the infested squares. They are probably *Bracon* sp. and *Urosigalphus* sp. Both are about equally abundant, though perhaps the latter is somewhat the more numerous. The percentage of parasitism has not yet been determined, but the indications so far are in the neighborhood of thirty per cent and perhaps very much more.

The heat from January to March in the northern coast strip of Peru is excessive, and the rainfall is practically *nil* for long periods

of years. The last thoroughly wet summer here was in 1891. During the cooler months, from June to October, there is considerable moisture in the air, especially during the night and the early forenoon. The weevil can flourish here only during the cooler weather, its greatest influence on the crop being visible in July and August. Cold, with humidity, is thus seen to be the indirect cause of the damage, in so far as it allows the weevil to become and remain active.

It was noted in Piura Department that the season following the wet summer of 1891 showed a practical absence of hielo symptoms, the heavy floods having probably destroyed the major part of the weevils in the cotton districts.

It should be noted here that I have not as yet found the weevil attacking the bolls to any extent whatever. So far as I have been able to ascertain, its injury is confined to the squares, and the term square-weevil therefore seems fitting. But it must be stated that cotton grows and produces squares the year round in this country, and it is highly probable that in the absence of squares this weevil would attack the bolls in much the same manner as the boll-weevil.

Since the present species is so closely similar to the boll-weevil in general form and appearance, if not in structure, and has practically identical habits, it may be seen that its investigation throws important light on the boll-weevil problem in North America. While the boll-weevil has spread northward through Mexico into Texas, and eastward into the humid cotton area of the Southern States, it has been noted with surprise that it has never become established in the extensive cotton growing region of Mexico known as the Laguna District. The latter is extremely hot and dry, lying as it does in a low basin of the plateau region. On a trip which the writer made to Yucatan in May, 1896, only one specimen of the boll-weevil could be found. May is the height of the dry season in Yucatan, and the weather was extremely hot. The boll-weevil is much less serious in the central and western parts of Texas than in eastern Texas and Louisiana. The former are very dry and hot as compared with the latter. It has been noted that since the boll-weevil entered the humid part of the cotton belt its progress has been much more rapid and its damage more serious. It has long been recognized that heat and drought are the most potent factors in the natural control of the boll-weevil, but we were not at first prepared to accept them as an actual barrier against its spread. Such, however, seems to be very largely the case. Comparing the facts in both cases, it becomes evident that the boll-weevil of North America and the square-weevil of South America are alike in their inability to withstand great heat and drought.

It may be inferred as extremely probably that Anthonomus is a

humid boreal type which has been gradually spreading southward during recent geologic time, probably since the last advance of glacial cold. It is not yet adapted generally to the conditions of the warm arid regions, but has extended southward especially within the confines of the humid plateau area. The boll-weevil has been found as far south as the high interior of Guatemala; while its smaller relative, the square-weevil, occurs in the warmer mountain region of South America. These facts account for the rapid spread in recent years of the boll-weevil northward and eastward into the cotton belt of the Southern States, and its ready adaptation to conditions of winter cold. Its greater multiplication in the humid areas of eastern Texas and Louisiana is in accord with these facts.

Quite possibly both weevils have no other present food and main plant than cotton, having become adapted to it perhaps within the lifetimes of the species. The immediate stock from which they sprang doubtless possessed some other malvaceous host-plant. One might imagine that the boll-weevil, from its larger size, has been longer adapted to cotton than the square-weevil. In spite of much search, including a three weeks' overland trip into the Andes of southern Ecuador, from which I have just returned, I have as yet found the square-weevil on no other plant than cotton. Still more strange to say, on the above trip I was unable to find a single weevil in squares of cotton plants in the higher country after leaving the Chira valley, although conditions for them seemed most favorable. My route was northeast, toward the center of the Cordillera; and I am constrained to believe that directly north of here, in southwestern Ecuador, the weevil may be found, but probably only in wild cotton.

In view of all the facts in the case of both weevils, it is evident that great interest attaches to the question of the native home of the cotton plant. I have long been inclined to believe that it is not native to America, but came originally from the Orient, the seed having been brought here thousands of years ago by those early adventurers who gave rise to the Maya and pre-Inca civilizations of Central American and Peru. With the hope of throwing some light on this very obscure point, I have communicated with several prominent archæologists and botanists who have made special study of the subjects and regions in question. Dr. Max Uhle, director of the Museo de Historia Nacional, in Lima, and the leading authority on Peruvian antiquities, writes me as follows:

The culture of the cotton plant in South America must have been known at a very early period. It must be so since the cultivation of *Algodon silvestre* is found everywhere east of the Cordillera. The grave finds of cotton textiles, cotton seeds and seed-pods date from the remotest times. Also with the primitive fishermen of

Ancon and Supe, cotton fabrics were known and used at a period long before the Christian era. The native cotton plants of central and southern Peru of prehistoric times were quite different from those introduced from North America and elsewhere. That variety which is cultivated at Piura is closely related to the native plant of pre-Spanish Peru (central) and also to the *Algodon silvestre* of the region east of the Andes, both in size and in general type, and doubtless is a derivation of the primitive native plant. I do not know wherefrom (in Africa or Europe) it could have been introduced originally. I, as an archæologist, am satisfied to regard it as a native plant. It is, however, remarkable that there is a cotton plant of similarly high stature and like perennial character in India. This is a question I leave to the botanists to clear up.

Mr. G. H. Powell, acting chief of the Bureau of Plant Industry, in Washington, in the absence of Doctor Galloway, chief of the Bureau writes as follows:

I beg leave to state that the nearest wild relatives of the cotton plant are all natives of America, and the tree cottons of the American tropics have doubtless always been American. In the northern part of the Andes the natives knew how to spin cotton even before they were acquainted with the llama and vicuña, as is shown by the numerous clay spinning tops found in Colombia. Almost all of the primitive languages of Central and South America have distinct words for cotton. The origin of our present upland cotton is somewhat in doubt, however, and recently evidence has been presented with the object of proving that the upland type of cotton was first developed in Asia.

The Asiatic series of cottons have no representatives in the New World, except such as are known to have been introduced; and, on the other hand, Asia possesses no species of *Ingenhouzia* and *Cienfuegosia*, the nearest wild relatives of the cottons.

Prof. T. A. Cockerell, of the University of Colorado, writes:

The genus *Gossypium* has native species in the neotropical, Ethiopian, Australian and Oriental regions—even (*G. drymarioides*) in Hawaiian Islands. It is evidently an ancient genus. The Australian species are perhaps to be separated as *Sturtia* R. Br. 1849.

The consensus of opinion thus seems in favor of the nativity of cotton in America, and I will not attempt to deny its probability. It has certainly quite evidently existed here for a very long period of time.

It is thus possible that the square-weevil has, in any event, existed in Peru as a pest of cotton for upwards of 2,000 years. The Incas cultivated cotton here, probably more in the cooler and damper areas of the country than in the present area. It is significant that the weevil took hold of the crop the second year of its more recent planting in Piura (1865). It must have been present in the country, perhaps in wild cotton. Similarly it is probable that the boll-weevil has existed in cotton in Central America for a much longer period than 2,000

years. The old ruins of Yucatan, southern Mexico and Central America were built by a race which long preceded the Aztecs. They almost certainly cultivated cotton, and it is highly probable that they brought seed with them when they came to America. They quite certainly came from the Orient, probably from India, perhaps from Egypt. The possibility is thus introduced of the boll-weevil and square-weevil as well having both been imported into America from the Old World by these ancients thousands of years ago. No statements are intended to be made by the writer in this connection, but the points of possibility are merely mentioned. The testimony of students of *Anthonomus* is needed in this connection.

Considering all the foregoing facts as well as possibilities, and especially the influence upon the weevils of high aridity in the warmer regions, what, then, is the outlook for future cotton production in the Southern States and in Peru? We know not only that the boll-weevil is by far the most serious enemy of cotton that exists under present conditions in the Southern States, but also that it is bound to invade the entire cotton belt in spite of all measures that can be taken to prevent it. Its great seriousness rests on the fact that practically all of the cotton belt of the Southern States lies within the humid, warm temperate region. The square-weevil of Peru, though a potent factor at times under present conditions, here holds no such serious menace to the crop; and this is because the cotton area of Peru lies practically all within the arid coast strip.

It should be recognized by cotton planters that the warm arid regions of the globe, with their long, hot and dry summers, served with a certain amount of irrigation, have been found to produce a far higher quality of cotton fiber than has ever been raised in humid regions. The native Peruvian, and other varieties of cotton cultivated in the excessively dry and hot coastal valleys of Peru bring as high as twenty-four cents gold on the Liverpool market, and average twenty cents or more. While the upland cotton of the Southern States is bringing fourteen cents, exactly the same variety produced in Piura Department brings twenty-two cents. The difference is entirely in quality of fiber, due wholly to the climatic conditions of the hot arid region with its great heat and dryness.

The natural cotton regions of the world are Egypt and the Soudan; the southwestern United States; northwestern Mexico; the west coast of Mexico, Central America, and South America in certain districts, as notably the coast strip of Peru; parts of South Africa, India, etc.

The natural cotton region of North America may be defined as follows: Western Sinaloa and Sonora, southwestern Arizona, south-

eastern California, the Laguna District of Mexico, with certain hot semi-arid districts of the Pacific coast of Mexico and Central America. A small part of southwestern Texas might also be included. The time will no doubt come when cotton production will be abandoned in the humid area of the Southern States, and the area of production of this crop transferred to the warm arid region just mentioned. When the boll-weevil has become distributed throughout the present cotton area of the United States, the annual loss from its effects, in spite of all methods and agencies that can be brought to bear against it, will probably exceed $50,000,000. Why should this loss continue to be incurred and carried year after year, when a new cotton region which will produce a far higher grade of fiber worth a higher price awaits exploitation?

Let the Southern States raise other crops that are better suited to their conditions, and move the area of cotton production to the southwest where it belongs. The boll-weevil will not trouble it there. Such action will not be realized for several decades, it is safe to say, and I will no doubt be set down as a foolish theorist for making the suggestion. However this may be, I rely upon my firm conviction that the change will come eventually and that time will prove the soundness of the suggestion. This change will be, moreover, brought about primarily by the influence of the boll-weevil. Thus the plague will prove a blessing in disguise.

The arid cotton districts of Peru have little to fear from either of these weevils. The native Peruvian and other varieties of cotton here are allowed to grow and produce for several years in succession, the first variety giving its best crop during the second year. Such system of cultivation allows the weevil full sway, so long as it can withstand weather conditions, and also favors greatly several other serious pests as well. A change in system of cultivation to that of North America, or even the cutting back of the plants once a year, will effectually put the crop beyond the reach of the weevil here, and at the same time reduce other pests to a minimum including the piojo blanco. Thus North America needs for the betterment of its cotton production the hot arid climatic conditions of Peru, while the latter needs for the same purpose the North American system of cultivation. Supply these respective needs by a simple exchange of ideas put into active execution, and the cotton crops of both countries will be practically free of plagues.

A SIMPLE AND CONVENIENT SYSTEM OF KEEPING GENERAL ENTOMOLOGICAL RECORDS

By CHARLES H. T. TOWNSEND, *Piura, Peru*

The system described below was devised a year ago by the writer on his arrival in Peru. It is especially adapted for use in a region where little or no entomological work has previously been done, and where much time must elapse before determinations of species can be secured, but it is equally applicable to all general entomological work. It has been in use for a year, and has so far fulfilled every reasonable expectation.

Note slips of the standard card-catalog size are used, but any size desired can be substituted for these. Colored cards are used for heads. Plant names are the chief heads, but certain others are included as suit the needs of the work. A single species of plant may form a head, or a single genus; and likewise a single species of insect, or a group of insects. Insect heads are used only for certain groups or categories that do not fall naturally under plant heads, or for certain injurious species that are being exhaustively investigated and dealt with economically.

The heads are allotted numbers from 1 to 1,000, usually two numbers being reserved for each. In exceptional cases four numbers are reserved for a head. Thus *Hemichionaspis minor*, which as a pest of cotton, is being specially investigated in Peru, is allotted numbers 1, 2, 3, 4, head to include not only that species but all allied species whose parasites promise well for use against it. Two numbers are given to *Dysdercus*. Six numbers are reserved for the cotton square-weevil and its allies, whose parasites may be used against it; since it has recently developed that this newly discovered cotton weevil is the cause of more damage to cotton in Peru than all other insects combined. Two more numbers are given to all other cotton insects. The great mass of heads are plant heads, but non-plant heads other than the above are human and animal disease-transmitters and parasites, wasps, bees, stored foods, silk, hides, drugs, collected microparasites and others not connected with hosts, coccinellids, ants, termites, locusts, household insects, jiggers, ticks, museum pests, etc. These are all the non-plant heads that have so far been needed, and these with the plant heads have brought the numbers in a year to the 800-mark.

When the first thousand numbers have been used for heads, the same numbers can be used over again with the letters of the alphabet prefixed; as A1 to A1,000, B1 to B1,000, etc. This allows of an indefinite number of heads. The heads and slips are arranged consecu-

tively by numbers. The colored catch cards bear the head, and its initial numbers, as:—247,—248, citrus fruits.

Under each head numbers are multiplied as follows: A head with numbers 247, 248, follows these numbers with 1,247, 1,248, 2,247, 2,248, 3,247, 3,248, etc. Thus a head with two numbers admits of two hundred species being placed under it before the numbers reach the six-figure space. In all cases the final numbers are the same for a head.

The system, as so far outlined, applies only to insects that are found on their respective food-plants, and to those falling under the non-plant heads adopted.

All enemies, whether parasites or predatory insects, of the species under the above heads, are designated by adding to the host-number the following:

°a — Egg-parasites.
°2a — Dipterous entoparasites of any stage.
°3a — Hymenopterous entoparasites of any stage.
°4a — Heteropterous predators of any stage.
°5a — Coleopterous predators of ditto.
°6a — Lepidopterous predators.
°7a — Dipterous predators.
°8a — Neuropterous predators.
°9a — Hymenopterous predators.
°10a — Acarid ectoparasites or predators.

Other enemy heads can be added for stylopid or other entoparasites, and for other predators or ectoparasites, etc. The letters of the English alphabet are to be used, and then doubled, tripled, etc., if required; as 247°3a to 247°3z, 247°3a2 to 247°3z2, 247°3a3 to 247°3z3, etc., variations as preferred may be adopted.

Hyperparasites, etc., can be numbered with a repetition of the above enemy suffixes added to the host-number; as 247°2a° 3a to 247°2a °3z, etc.

I have used the suffix °20 (a to z, etc.) for fungous diseases; others can be added for bacterial diseases, etc.

It will be seen that this system is highly elastic, and can be used at once before the names of any of the species of insects are known. Only the names of the plants are needed.

An index of the heads is kept separate, for the purpose of readily finding the numbers belonging to each.

With any other system the greatest confusion exists until the species of insects are known by name. With this system, order is maintained throughout, as well as a food plant catalog of the species.

Under the present system, as soon as species are identified, the slips belonging to them may be arranged under generic heads in alphabetic order, thus transferring the same slips from the original plant and other head system of the first index to a second index system using the generic names of the insects. At the same time the names of the insects are entered under the original plant and other heads, and the first index is thus retained as a cross-reference catalog to the food-plants and habits.

It will be seen that when a species has two or more host plants or host insects it will receive as many numbers under the respective heads. Also species associated with one being specially investigated for purpose of bringing together at a glance the parasites available for the latter will take further numbers in consequence. This may be thought a serious objection, and on this account I at first had some misgiving as to the system, but it has not proved so in practise. It makes no difference finally how many numbers a species may have, since each number must necessarily refer at once to the species; on the other hand, it would cause great confusion if two or more species were to appear under the same number. Upon the identification of a species, all the slips, under whatever numbers, come together under its name in the second index, and at the same time the records are left for cross-reference in the first index. The first is a number index, relating to food-plants and habits; the second is a name index, relating to genera and species. The first index system, with names incorporated, will be found of immense practical advantage as a supplement to the second index system.

While this scheme has been devised to meet the wants of an isolated region where entomological work is being inaugurated practically for the first time; it will be quite readily applicable to general economic work at any stage of records. Such species of insects as have been determined will appear in the second index while all notes on species still unnamed may be renumbered and arranged, with new slips of those determined under the first system which is thus elaborated into a food-plant and food-habit index. Such renumbering should prefix some character to the above numbers, as N (meaning new number), or an asterisk or Greek letter, or the number may be written in red ink or otherwise distinguished until the old numbers have been exceeded. The new numbers can be added to the specimens without removing the former numbers. For the second system a generic index is found in the head cards alphabetically arranged. The beauty of the whole scheme is that it is capable of immediate application, without the necessity for the names of the insects being predetermined, and of systematic and unlimited extension on the same lines as begun, the

records of any species being at once available at all times. I am able at a moment's notice to find any particular note that I have made during the past year on any one of the hundreds of species of insects studied, whether yet determined or still without name, and anyone who familiarizes himself with the scheme as outlined can do the same. This is of course the test of any system of note keeping. Its proof is in its convenience and utility. I know of no other general record scheme that is at once so simple and so conveniently available at all stages of the work.

SOME WAYS OF REACHING THE PUBLIC

By H. A. Gossard

Last year I presented by title to the Association of Economic Entomologists a paper which has since been published in the Journal of Economic Entomology on "The Value and Make-up of State and County Fair Exhibits." In this, I discussed *one* of the methods I use to acquaint the public with the entomological work of the Ohio Agricultural Experiment Station. This special feature of our work will, therefore, need no further mention in this paper. It is with the hope that a discussion of other methods of gaining publicity may bring to me some profitable suggestions from my fellow-workers and that I may impart a few to them that I offer this paper.

Of course, the main reliance of the official economic entomologist for publishing his results must be through the customary medium of publicity used by the institution with which he is connected. This is usually by means of the bulletin, circular and annual report. Professor Sanderson has given so good a discussion relating to "Publications of the Station Entomologist" in No. 4, Vol. 2 of the Journal of Economic Entomology that I shall pass over this subject quite briefly.

I wish, however, to emphasize the recommendation that such publications be generously illustrated. A carefully chosen, significant cut on the outside cover page of such a pamphlet secures for it a favorable impression before it is perused, and nearly always insures its being read. Abundant and good illustrations should also be scattered through the body of the pamphlet. The contents of the bulletin must, of course, depend upon the studies of the writer, but every entomologist has many lines of work open to him, and he should remember in making his selection that some of these will yield immediate and valuable results to his constitutents, while other questions equally easy to choose, and equally important, considered from the

standpoint of the monetary values involved, may be far more baffling of solution, and may require long periods of observation and research to obtain any sort of satisfactory results—in fact, they may be incapable of satisfactory solution at all. No one thing has done more to strengthen the Entomological Department of the Ohio Station with its constituency than its work in spraying apples. The methods employed were largely transplanted from the states of the Far West, being chiefly adaptations of the methods first strongly emphasized by Dr. E. D. Ball, but these methods would not have been generally adopted or used to any considerable extent for a long time if the Experiment Station had not tested their value and adaptability to Ohio conditions. Because of his service to the state in thus giving a great impetus to the resurrection of the fruit-growing industry, the entomologist has gained such financial support that he has been enabled to direct the leisurely investigation of some of the more difficult and abstruse problems, the results of which, considered by themselves, would have brought him very meager support, comparatively speaking. It often happens that after years of faithful and conscientious work on an injurious insect, the investigator can do but little more than give a full account of its history, habits, instars, etc., confessing that adequate remedial measures have not been found. While such work is valuable and must be done, the wise director of research will so distribute his effort that part of it is likely to produce strikingly successful economic results, part of it will be given to important questions that do not seem to hold out any immediate promise of successful solution, and another part of it can be devoted to the strictly technical work which interests only the professional entomologist.

If the most promising fields of work are neglected, no amount of faithful plodding or persistence in trying to solve more difficult problems will secure for the Agricultural Experiment Station Department of Entomology the standing with its constituents that can be obtained from doing well some important piece of work that contributes directly and obviously to their pocket books. So far as the public is concerned, it does not matter so much whether the work is entirely new and original or whether it is largely demonstrational in character. Where demonstrational work is provided for through other agencies than the Experiment Station, more time is, of course, left to the station entomologists for original research, and it is desirable that a considerable part of their time be left for this purpose; but in my opinion there is always likely to be sufficient material for original observation in any large-scale demonstrational experiment to justify the required outlay of time and money to accomplish it, aside from considering the increased prestige gained for the department.

This increased prestige often leads to such increased support that instead of being a handicap to research, as appeared probable when the work was commenced, it becomes a means of distinctly furthering original research. The chief point is that he who would go before the public with a message of any sort, whether it be original or merely demonstrational, must have a message that the people understand and which touches their welfare. They would far rather be taught how to utilize old knowledge that is of great value to them, than to be given tedious and unimportant information that is entirely new. The support they give will be proportional to the benefit *which they think they have received.* Demonstration meetings are very useful for arousing interest. A good discussion of the value of these is given by Prof. Franklin Sherman in No. 5, Vol. 2, of the JOURNAL of ECONOMIC ENTOMOLOGY. In Ohio we have made use of about the same methods as Professor Sherman in conducting spraying demonstrations. The railway companies are generally glad to distribute advertising matter along their lines and to put up posters in their depots throughout the territory that is likely to furnish excursionists to the demonstration orchards. Considerably more important than spraying demonstrations have been our field meetings to study results of the season's work. The first of these was held in the Schmitkons orchard in the fall of 1907. The results of spraying in this orchard are set forth in Bulletin 191 of the Ohio Station. Besides a detailed explanation of how the spraying had been done on the different plots, illustrated by a spraying outfit in action, water being used for the liquid, a diversified program was prepared covering several phases of orcharding. The station horticulturist was present and gave a lecture on pruning and culture of the orchard, the station botanist gave a lecture on orchard diseases, and a practical orchardist gave an address on marketing and packing.

All of the arrangements were made by the State Horticultural Society, and so successful was the meeting that it was decided to have an annual field meeting of the society each fall at some place where practical lessons could be learned. The same general plan in regard to program has been followed at subsequent meetings and while these have not always been held in orchards that were in charge of the Entomological Department, entomological topics have always had a place on the program. They have generally been held in an orchard which was for the season in charge of some one of the station departments, but in some cases have been taken to the orchard of some expert fruit-grower who was able to teach valuable lessons from his orchards and his fruit-growing methods. The present autumn, the field meeting was held at the Station orchards at Wooster. These

were all used during the season by the Department of Entomology for spraying experiments in which the effects of the different combinations of sprays such as lime-sulfur and arsenate of lead, and bordeaux mixture and arsenate of lead in different proportions were shown on foliage and fruit. At an earlier date, about midsummer, all the farmers' institute speakers employed by the state assembled in a convention were conducted through the same orchards and explanations were given of the work being done and the treatment that had been given to the different plots. The reports of these autumn field meetings of the Ohio Horticultural Society have been printed and distributed as circulars of the Ohio Station. A good idea of what is done at these field meetings and the nature of the papers or off-hand talks presented, can be obtained by consulting Circulars 87 and 103 which contain quite full details.

The farmers' institute also furnishes a method for reaching a good many people. It often happens that a man will read with interest a bulletin, the author of which is personally known to him, when it would hardly be noticed if the writer were a stranger. There is a limit, however, to the amount of institute work that can be done by the research student, and it is generally necessary to discourage calls of this kind rather than try to multiply them. At the Ohio Station we print a folder each fall which contains the following introductory paragraph:

The members of the Station Staff named below are prepared to assist at a limited number of independent farmers' institutes and similar meetings. No *per diem* is charged for this service, but it is expected that the speakers will be reimbursed for their necessary traveling and hotel expenses.

Where two or more names are given at the head of a list of topics requests may be made for discussion of any of the topics on the list by any member of the department. The lecturer requested will be sent if possible, but if conflicting engagements make this impossible, some other person qualified to discuss the subject will be sent.

At the head of the list of entomological topics we print the names of the entire entomological staff as far as they are available for such work, thus:

DEPARTMENT OF ENTOMOLOGY

H. A. Gossard.
W. H. Goodwin.
R. D. Whitmarsh.

1. How to spray the apple orchard. (In some of our experiments the net returns have averaged $400 and $500 per acre for a single crop.)
2. How to spray peach, pear and plum orchards.
3. How to treat the vineyard to prevent Grapeberry worm and other insect enemies of the grape.
4. Home-made sprays, commercial insecticides and spraying machinery.
5. Our allies in the war against insects; birds, insectivorous animals, parasites, fungous and bacterial diseases.

6. Insects injurious to stored grain and how to prevent injury.
7. Insects injurious to cereal grains.
8. Insects injurious to forage crops.
9. Insects injurious to garden crops.
10. Insects injurious to potatoes.
11. Insects injurious to shade and ornamental trees.
12. Insects injurious to livestock.
13. How to treat San José scale.
14. How to treat the Fruit Bark Beetle and other borers.
15. Wonders of the Insect World (40 minutes night stereopticon lecture, many slides in natural color.)
16. Some birds and small animals, good and bad; their habits and value (40 minutes, night stereopticon lecture, several colored slides.)
17. Relation of insects to human welfare (40 minutes, night, by H. A. Gossard.)
18. Spraying machinery (40 minutes night stereopticon lecture, by W. H. Goodwin.
19. Any entomological topic not listed will be discussed if request for the same is made two weeks before the institute.

In our experience, simple talking without any illustrative material is not satisfactory. We have several ways for illustrating our lectures. For day lectures we make much use of enlarged bromide pictures. Life histories of insects, character of damage wrought by them, comparative results of treatment, different types of insecticidal machinery, etc., are quite susceptible to this kind of illustration. We use pasteboard mounting cards about 20 x 24 inches, or larger, so they easily take plates 16 x 20. These will carry illustrations sufficiently large to be seen readily by all the members of an average institute audience of 100 to 500 people. To economize weight we sometimes put a plate on each side of the board and sometimes we mount the plates on sheets of cloth instead of board. To carry these illustrations we wrap them in a cover of oilcloth and put a shawl strap about them. The lithographic chart recently prepared by Prof. F. L. Washburn of Minnesota for use in the schools of his state seemed so well adapted for institute work that I have had this backed with cloth and expect to make more or less use of it in giving the introductory lecture at institutes. Our Ohio institutes are usually for two days, and each worker is generally expected to give four and sometimes as many as six lectures during the session. For evening lectures we make much use of the stereopticon. The Bausch and Lomb Optical Co. have built a portable lantern according to specifications furnished them by our Messrs. Houser and Goodwin which can be mounted on an ordinary camera tripod and the entire machine with accessories, excepting the slides, can be packed in an ordinary suit case and weigh, when packed, but little more than thirty pounds.

We use an alco-lite attachment with this machine and find it quite satisfactory. We have also an electric lantern which we use in build-

ings that are wired and supplied with electricity and where exceptionally large audiences are expected, but this machine is altogether too heavy for general use. We have several hundred lantern slides, three or four hundred having been chosen from the Slingerland list and we have made about as many of our own. We have just as many as possible of these in natural colors and arrange them so as to give a connected and logical lecture. The first slide is generally the one which shows the division of insects into two groups, those with sucking and those with biting mouth-parts, then a series illustrating complete and incomplete metamorphosis is shown, then slides illustrating fecundity, parasitism, predaceous forms, the work of bacterial and entomophilus diseases, the functions of birds and insectivorous animals, mimicry, etc. After this introductory matter, special consideration is given to such insects as are apt to be of most local interest or which illustrate the day lectures. Some of the finest, most beautiful, and surprising slides are always reserved for the close of the lecture. Topic 16 has been added to give a wider range of choice and to accommodate audiences which in preceding seasons have heard No. 15. Mr. Slingerland has prepared many of the bird slides for us and we have made a good many ourselves. Besides birds, the rabbit, the rat, the skunk, the mole, the shrew, the woodchuck and the toad are considered. The natural history of these is discussed in more or less detail and suggestions for control or propagation are furnished. Many insect slides are worked into this lecture to illustrate the food habits of birds. Topic No. 17 is the article published in No. 5, Vol. 2, JOURNAL OF ECONOMIC ENTOMOLOGY. This is a somewhat heavy lecture for the average audience and though generally well received, I doubt if it leaves so lasting an impression as the stereopticon lectures and I know it is not so popular. The evening lecture by Mr. Goodwin on "Spraying Machinery" is very practical and is generously illustrated with a splendid set of slides of our own making, but we have not yet had time to determine whether or not there will be much call for it. The county schools of agriculture lasting from one to two weeks each, also offer an opportunity for giving short courses in entomology, and will, doubtless, supplant the farmers' institutes in time. These are comparatively new developments in Ohio agricultural education, and we have thus far had little opportunity to test their possibilities for entomological instruction. The horticultural and agricultural train offer some opportunities for scattering information, but thus far, we have not tried to utilize this method of propaganda. I believe Mr. Shaw of our state department of Agriculture and the Department of Agricultural Extention at our state university have used it with considerable success.

The midwinter Ohio Apple Show at Columbus, held in conjunction with the annual meeting of the State Horticultural Society, affords an opportunity of which we are glad to avail ourselves to exhibit our spraying results to the public. We purchase whatever apples are necessary from the orchardists, with whom we coöperate, to show the results of spraying upon insects, the effects of different sprays in causing russeting, etc. Our State Horticultural Society always expects a report from the station entomologist, and from the state inspector of nurseries and orchards as well, upon the observations and results of the year's work.

The agricultural newspaper furnishes an easy means for exploiting station work, but I am obliged to confess that I have utilized it far less than I should have done for this purpose. While I have occasionally volunteered an article for the *Ohio Farmer* and for other agricultural papers printed in the state, I have, for the most part, confined myself to answering such questions as were submitted to me by the editors with the request that I answer them. As between too much or too little publicity through newspaper writing, I believe too little is preferable, but am satisfied that I would help more people if I contributed at least one good practical article each month. One disadvantage about too much publicity, especially of the kind gained through newspaper writing, is that departmental correspondence is apt to become too burdensome and encroach too much upon the time of the staff. We are now obliged to anwer from 5,000 to 7,000 entomological queries per year at the Ohio Station and we almost wish it were unnecessary to ever increase the number. I am now asking the Legislature for the means to hire a clerk who can be trained to answer a large fraction of these without consulting the entomologists except to make certain the identification of insects. To enable him to do this the more readily, we expect to prepare short printed accounts of the life histories and habits of the more important economic insects with recommendations for treatment against the same. I am satisfied that this will be more satisfactory to all parties than our present method and at the same time, cheaper than sending out a bulletin or circular in answer to each inquiry. In whatever way such inquiries are answered, enough of detail must be given to enable the inquirer to obtain a complete answer to all the questions he had asked and besides these, to all that he ought to have asked. If this care is taken to inform inquirers, the correspondence of the entomologist will increase fully as fast as is desirable, and I sometimes think faster. I keep small slips just large enough to fit into our letter envelopes, having printed directions on each for making one of the various sprays, for using poisoned bait for cutworms, for treating cabbage worms, for

combating the striped cucumber beetle, etc.; others giving the addresses of manufacturers of spraying machinery and of insecticides and such other information as is most frequently asked for. This saves much time in dictating letters and an extension of the plan would enable a bright clerk to take care of much of the correspondence without much help.

The time has long since gone by when the station entomologist can quietly remain at his office headquarters and prosecute his researches without interruption by his constitutents. Today they wish to know what he has done and what he is doing and it is apt to be his own fault if they do not value his advice as highly as they do that of other agricultural experts in different fields of endeavor. Upon his good sense and cleverness in presenting results that are worth presenting, will depend the continuance of the public favor toward entomological activities, now so happily achieved and held.

SPRAYING FOR THE EUONYMUS SCALE

By Z. P. Metcalf, *Assistant Entomologist, State Department of Agriculture, Raleigh, N. C.*

The euonymus is one of the most desirable hedge plants grown in North Carolina. It is evergreen, hardy, and with the exception of the euonymus scale seems to be free from diseases. This insect, however, is so destructive that what were once beautiful hedges are now reduced to scraggly clumps or the entire hedge has been cut down and removed.

During the summer of 1909, what had once been a magnificent hedge was turned over to us for experimental purposes. This hedge consisted of about one thousand feet averaging four and one-half feet high, and about two feet wide. This together with ten large clumps averaging thirty feet in diameter and twenty to twenty-five feet in height gave us an excellent chance to try out practical remedies. The hedge was in varying degrees of infestation. In fact, about three hundred feet of the hedge was so far gone that it was thought best to cut it down and reset with young hedge. About 90 per cent of the plants in the portion removed were dead, the remainder were very nearly dead. On July 16, 1909, kerosene emulsion, prepared in the usual manner, at the strengths of 15, 20 and 30 per cent oil was used on three different clumps of euonymus separate from the main hedge. All three clumps were badly infested. These clumps were inspected on July 23. At this time it was found that the 15 per cent kerosene emulsion had done very little good,—certainly not more than 10 per

cent of the scale were killed. The clump sprayed with 20 per cent kerosene emulsion showed, on an average, about 75 per cent killed. The clump sprayed with 30 per cent showed an average of about 90 per cent killed. None of the plants showed any injury whatsoever from the application of the spray mixture. It was, therefore, determined to spray additional clumps. On July 29 seven additional clumps, together with those originally sprayed, were sprayed with 30 per cent kerosene emulsion. This was repeated on August 11. On both dates the sun shone brightly all the time the spraying was going on and it was exceptionally hot, even for that season of the year. These clumps were examined on March 4 and it was found that about 95 per cent of the scale were killed on the clumps which had received two spraying with 30 per cent kerosene emulsion. The results were no better than this on the clump which had received one spraying of 15 per cent kerosene emulsion and two sprayings with 30 per cent kerosene emulsion. The clump which had received one spraying with 20 per cent and two sprayings with 30 per cent showed about 98 per cent of the scale killed. The clump which had received three sprayings with 30 per cent kerosene emulsion seemed to be practically free from scale and although it received no subsequent sprayings it remained free from scale, and was one of the most beautiful clumps on the lawn when last inspected on September 9, 1910.

On March 4 a new series of experiments was started. Six sections of the main part of the hedge, measuring about thirty feet each, were sprayed with the following mixture: Commercial lime-sulphur, 1 to 10 and 1 to 15. Scalecide, 1 to 10 and 1 to 15. Kerosene emulsion, 40 per cent and 60 per cent oil. These sections were examined on June 3, when it was found that none of the hedge had been injured by any of the mixture. Arranged according to their relative effectiveness they would rank about as follows: Scalecide, 1 to 10; kerosene emulsion; 60 per cent, scalecide, 1 to 15; kerosene emulsion, 40 per cent, lime-sulphur, 1 to 10; lime-sulphur 1 to 15.

On June 3 additional sections of the hedge were sprayed. Half of each of the blocks sprayed with scalecide on March 4 were sprayed with scalecide, 1 to 35. In addition ninety feet, which had not been previously sprayed, was gone over with scalecide 1 to 35 and sixty feet with scalecide, 1 to 25. Half of each of the sections which had been sprayed with lime-sulphur on March 4 were sprayed with lime-sulphur, 1 to 30. In addition two blocks of 150 feet each were sprayed with commercial lime-sulphur at 1 to 20 and 1 to 30. Half of each of the blocks which had been sprayed with kerosene emulsion on March 4 were sprayed with 30 per cent kerosene emulsion. In addition fifty feet of the unsprayed portion was sprayed with 30 per cent kerosene

emulsion as well as the seven large clumps on the lawn which had received only two sprayings previously.

The entire hedge was examined carefully, on September 9 the unsprayed portions were practically all dead. The portions sprayed showed varying degrees of infestation, from almost perfectly clean hedge to that which had been but slightly benefited. Taking into consideration the relative original infestation one was able to judge very accurately the relative merits of the different solutions used, as well as the benefits to be derived from sprayings applied at different seasons of the year. As far as we were able to judge there was very little difference between winter applications of strong solutions and summer applications of the same solutions used at weaker strengths. The best results seemed to be obtained by making one application of the stronger solution in the winter time and two of the weaker in the summer time until the scale is under control. After the scale is once thoroughly under control, we believe it can be held in check by one summer or one winter spraying each year, using either a soluble oil or kerosene emulsion. Our results would lead us to believe that early March, early June and early August are desirable times to make these sprayings under the climatic conditions of North Carolina.

Of the three materials tried, scalecide, 1 to 10 in winter and 1 to 25 in summer, would rank the highest. Next to this we would place kerosene emulsion, 60 per cent in winter and 30 per cent in summer. Either one of these materials seems to be an effective remedy for the euonymus scale. Our experience goes to show that these strengths may be used without any danger of injuring the plant. Commercial lime-sulphur did not prove to be an effective remedy in any of the strengths used. Although the hedge sprayed with commercial lime-sulphur showed decided improvement over no spraying at all.

Not the least important fact derived from these experiments to our mind, is that spray mixtures to be effective against this scale must be used at a much greater strength than heretofore recommended.

Brown-Tail Moth in Connecticut (*Euproctis chrysorrhœa* Fabr.).—The brown-tail moth was discovered in Thompson, Conn., in April, 1910, and later in Putnam. At Thompson several fruit trees found to be infested were sprayed with lead arsenate during May, and at the present time very few nests are found in that locality. The infestation at Putnam was discovered too late for spraying, and the nests were quite abundant on fruit trees in the city back yards. Scattering nests were found on trees three miles to the eastward, near the Rhode Island line. Local parties cut off and burned about five bushels of nests in Putnam, and later our state scouts went over the ground thoroughly and destroyed about 2,000 nests. The scouts are still working in Thompson at this writing, and though it is too early to generalize, it is probable that this infestation in the extreme northeast corner of Connecticut is the edge of the infested region extending through Massachusetts and Rhode Island, which has been close to the Connecticut line for at least two years. W. E. BRITTON.

Proceedings of the Ninth Annual Meeting of the American Association of Official Horticultural Inspectors

(*Continued from p. 129*)

Report of Committee on Treatment of Scale-infested Nurseries

The committee appointed at the Boston meeting of the Association to inquire into methods of dealing with nurseries infested with San José scale and to make specific suggestions pertaining thereto begs to report as follows:

As soon as the bulk of inspection work for 1910 was disposed of in our own states, the committee began an inquiry, sending letters to the proper authorities in each state as shown by the lists of the secretary of this Association.

In several instances no replies were received,—in one or two cases it was declined to discuss the matter,—in several cases merely the legal requirements of the state were mentioned without any description of the real methods of exact work done.

Your committee is glad to report, however, that a goodly number of satisfactory replies were received, for the most part from states where this work is of prime importance,—and in several instances hints or suggestions were given which we hope will be of interest.

The overwhelming testimony of the inspectors is in favor of the following genera scheme of treatment for nurseries infested with San José scale.

Treatment of Scale-infested Nurseries

1. A close general inspection to determine exact extent of infestation.
2. Every tree or plant actually seen to be infested destroyed.
3. Second inspection, if possible (tree by tree, if practicable) late in season or at digging time.
4. Fumigation of all stock remaining, after destroying all visibly infested trees.

In some states the fumigating is done by the inspectors,—in others the nurseryman signs an agreement or affidavit to do it and it is left to him,—in others it is required by law of all nurseries and left to them (with complete instructions) except in the worst cases, which are fumigated by the inspector.

Modifications practiced by different inspectors which are believed to make for better results are as follows:

1. In one state all cyanide is furnished through the inspector's office, thus insuring good, uniform grade and proper doses.
2. In one state it is required to spray all growing stock in nurseries where scale has been found with result that infestation is rendered less from year to year.
3. In one state a special form of certificate (stating that part of the stock *was* found infested), is issued to infested nurseries. No nurseryman would want such a certificate if he could possibly get a clean certificate.
4. One inspector destroys every plant found infested and all around it for a distance of twenty to thirty feet.
5. In one state all inspections after the first are charged for, the fee based on infested acreage involved,—so a nurseryman seeks to avoid more than the one regular inspection, which is free. In another state where second visit is needed or fumigation done by inspector, the whole expense is charged to the nurseryman.
6. Some states withhold the certificate until all the work of the inspectors has been completed.

It is usual to permit sales from infested blocks,—but only after all visibly infested trees are destroyed, and after fumigation (by nurseryman or inspector) of all the others. The making of tree by tree inspection and then *not* requiring fumigation is followed by one inspector with small nurseries, but fumigation is required of those doing a large trade. The fumigation, and later selling, of trees known to be infested has been permitted on some occasions in one state. Such concessions, which might appear dangerous, are usually in cases where the stock is destined for localities already infested and where the purchasers do not care whether it is infested or not, as it will be watched and sprayed anyway.

It is suggested that much would be gained if the fumigation of all buds, scions, etc., brought into the nursery could be secured,—but it is obviously difficult to enforce this. Intelligent and careful nurserymen might gladly adopt the suggestion.

From one state comes the suggestion for central quarantine stations where all entering stock should be inspected.

But it must be recognized in all work that the degree of thoroughness and exactness varies with the character of the man who inspects, and the character of the nurseryman. The time, money and force available for the work are also factors which cannot be eliminated. An inspector working alone, who has limited funds and time will readily make every possible concession to a conscientious nurseryman,—while an inspector with ample funds and time to look after details may be very exacting with a nurseryman whom he distrusts. We find that everywhere this human element enters,—and in no state, even with the most explicit laws, do we believe that it can be or should be eliminated. Flexibility, with much left to the discretion of a competent and conscientious inspector, seems to be one of the desirable points which is sought for everywhere.

FRANKLIN SHERMAN, JR., *Chairman.*

RALEIGH, N. C., December 23, 1910.

The report of the committee was received and the committee continued for the purpose of extending its investigations, so that a proper system of treatment can be outlined by the Association.

PRESIDENT WASHBURN: The next on the program is a paper "A Practical Method of Inspecting Imported Seedlings" by Mr. Symons of College Park, Maryland.

A PRACTICAL METHOD OF INSPECTING IMPORTED SEEDLINGS

By THOMAS B. SYMONS, *College Park, Md.*

The question of properly inspecting the large amount of imported trees, plants, seedlings, etc., that are now received annually in our several Eastern States particularly, and, in fact, throughout the country, due to finding the hibernating stages of the brown-tail and gypsy moths, as well as other pests, is one that has taxed the resources of state inspectors who are provided with limited funds for such work.

Indeed, I am frank to admit that I was ignorant until the past two years of the large amount of such stock that is imported into this country With a view of stimulating a discussion of the methods employed by the different inspectors and to show how this work is being handled in Maryland, this brief paper is presented.

Amount of Stock Imported

During the last spring the following approximate amounts and character of stock was imported by persons in Maryland:

2,302,300 French fruit stocks.
754,417 Holland fruit stocks.
149,325 Holland Ornamentals.
10,000 French Ornamentals.
Total, 3,216,042 seedlings, plants, trees, etc.

This does not include a quantity of herbaceous and florists' stock that was also imported. However, until this fall no attempt has been made to inspect some classes of this stock. As is quite general, I presume, the large majority of this stock is imported by nurserymen and wholesale dealers. Moreover, the bulk of the inspection has been up to this time seedlings of apple or allied plants.

In making arrangements for this inspection it was first thought best to employ the local inspectors and send a gang of ten to twenty to a place to go over carefully the large shipments of seedlings that were being received by different parties in the state. Upon a further consideration of the case, after consultation with the importers, it was found that the usual practice of growers was to carefully handle the seedlings, trimming both ends, and either place them in sand for a time or plant them in the field immediately. It was also learned that the seedlings should be handled as little as possible as exposure to air or added moisture would cause opposite but unfavorable conditions. The nurserymen desired that the seedlings be handled but once, if possible. The question to be decided was one of practicability *versus* theory. Whether we should inspect the seedlings by a score of inspectors at great expense, encountering the difficulties attending such operation, especially the unfavorable conditions of inspecting the seedlings when more or less packing was attached to them and placing them back in boxes, or to inspect the seedlings after the nurserymen had pursued their usual course in handling the trimming and preparing for healing in sand. Especially did the latter method appeal to me as it was decidedly the most economical and, I think, more effective. Our present method of inspecting large quantities of seedlings is as follows:

The nurserymen or grower provides a clean space in a packing shed and his force of men are put to work trimming the seedlings. These men are under the supervision of a personal assistant from the office who inspects all the seedlings after they have been trimmed. Instructions are given all the men to pull off all old leaves or anything that is attached to the individual seedlings. All found bearing a nest of brown-tail moth or other suspicious cocoon or egg mass are thrown out and destroyed by the inspector immediately. All packing is also destroyed and boxes properly treated by the inspector. Every precaution is taken to keep everything of a waste character in the given space, so that no opportunity is given for anything to escape. One inspector can carefully examine seedlings from thirty or forty men after they have been put in a convenient shape for handling.

Thus one man has been able to properly care for the inspection of an enormous amount of stock at one place. The inspection has not interferred with the routine of nursery work, and the whole has been taken care of at a minimum cost.

One of our greatest difficulties is the proper inspection of consignments to department stores, auctioneers, etc. During the past year a quantity of miscellaneous ornamental stock has been received by such parties in Baltimore. In such cases the conditions are not as favorable for thorough work as at the nurseries. It is a question if such stock consigned to parties in the immediate vicinity should not be inspected at a quarantine station.

In performing our duty as state inspectors I believe we should stand firm on our requirements, for the best interests of all concerned, but I believe we should be as practical as possible in devising methods so that such provisions may be successfully carried out.

We must maintain the confidence and coöperation of both the grower and nurseryman. Nothing will so easily dispel this confidence or lessen a coöperative spirit among growers than lack of efficiency in work undertaken due to impractical or costly methods of procedure.

President Washburn: The chair would like to ask Mr. Symons what precautions are taken regarding the cuttings or trimmings before the inspector takes hold of the work.

Mr. Symons: Nothing is done until the Inspector arrives.

Mr. Burgess: I would like to ask Professor Symons what is the method of handling the consignments that go to the auctioneers.

Mr. Symons: Up to the present time it has been a rather ineffective form of inspection. Practically all of this stock has come from Holland, and in our experience, we have never found anything on Holland stock.

Secretary Symons: I would like to ask Mr. Atwood what is his manner of procedure in inspecting stock in New York.

Mr. Atwood: The trees are overhauled, and if the stock is open we are expected to give thorough examination. The nurserymen are required to bring the stock up and put it on tables where the inspectors can see the whole thing. The stocks, roots and packing are examined for brown-tails, and for detached portions. In taking a bundle from a box it is very easy for some of the infested material to be left in the packing, we burn the packing from a box wherever a brown-tail nest has been found; or, in the case of the cast skins of the gypsy moth, we require that the packing material and the box also be burned.

Secretary Symons: Do you inspect the seedlings before they are trimmed?

Mr. Atwood: The nurserymen have been required to dip them in miscible oil, either before or after, depending on conditions. Some of our largest importers will distribute boxes among their plantations, and they have to be examined there, and we have to move around rapidly enough to cover the ground. The inspector insists on anything that will facilitate inspection. If a large quantity of seedlings are to be handled, and the room is large enough they are spread out on tables. I think your method of handling large quantities under favorable conditions is most excellent, and you ought to accomplish the result of letting no pest get by you. Your paper is excellent, and the method suggested is good where you can do that, but suppose you go to a nursery where the proprietor has eight or ten boxes in a dark cellar, and the man has no place to unpack indoors, and the weather is too cold to do it outside, you have to do the best you can. I think our inspectors are not inclined to be easy with any one who wants to cover up anything.

Secretary Symons: I understand that a great many states inspect seedlings prior to trimming. In regard to the case you mention where the stock is not in a convenient place for inspection, or it is too cold to inspect it outside, would it not be better to wait until the nurseryman is ready to handle the seedlings, rather than make him go to the trouble and expense and possibly subject the seedlings to unfavorable conditions?

Mr. Atwood: I think it is the pruning of the seedlings that has kept us from the brown-tail moth. Years ago, before we had heard of inspection, the hands were told that any insect should be destroyed.

Mr. Summers: I have been forced, because of lack of funds, in practically the same manner Professor Symons speaks of, to try to impress on our nurserymen, chiefly the shippers, the necessity of being very careful. They are extremely anxious not to let any brown-tail

moth get by them, because they do not want it on their own stock, and more particularly because they do not want it on the larger amount of stock which they ship out. Our most reliable nursery last year placed two men as supervisors over their trimmers and graders. They were talked to by the importer and by myself. The proprietor urged upon them the absolute necessity of care, and the two men, his own most careful foreman, were given to understand that nothing must get by them. I had an inspector myself on the ground, and one brown-tail nest got past them all. The trimmings were cleaned up thoroughly and burned every day.

President Washburn: Do you think it is perfectly safe to let the nurserymen trim before they are inspected?

Mr. Summers: I thought it was better to do so. The brown-tail did get by them in two cases; one was a shipment into Illinois; the other one was found after the seedlings had been set out the next spring. We have adopted the policy of going over all seedlings as soon as possible after they are set out.

Mr. Engle: These conditions differ somewhat from those in my state. There are two of us that inspect. All bundles were opened in our presence and gone over, and passed on to another set of men, who tied them up and took them away, and no trimming was done whatever. Every package was opened and examined, except such varieties as were practically all roots, which we did not open.

THE PRACTICABILITY OF NURSERY QUARANTINE STATIONS

By A. F. Conradi, *Clemson College, S. C.*

For a number of years we have had laws in the various states to govern interstate shipments of nursery stock. The object of these laws is to protect the respective states against the introduction of certain injurious insects and plant diseases. The laws of most states closely resemble each other as far as the provisions contained therein are concerned, though the rules and regulations governing the various inspectors, vary to some extent.

A mere law is not much of a protection unless the act and the rules and regulations give wide latidude to the inspectors. The efficiency of a law is mostly governed by the inspection force. The writer has found badly infested stock bearing a certificate signed by one of the most conscientious and one of the oldest entomologists in this country. It was never inferred that this was a blunder on the part of that entomologist. It is merely assumed and without hesitation that the official whose name appeared on the certificate had never seen the stock.

Though this consignment was fully covered with the necessary tags and certificates, yet it was so badly infested that the infestation was in evidence by merely glancing at the shipment. This occurred some years ago. Minor cases are coming to our attention from time to time. It is especially discouraging when these shipments are sent into sections of the state where considerable effort has been put forth to eradicate scale.

In South Carolina we have worked hard to eradicate scale from the state and in several instances we have confiscated or returned shipments found at railroad stations. These shipments were properly covered with tags and certificates, but these were certainly no protection to us. It is merely a question as to how frequently such consignments are shipped,—not only into South Carolina, but into other states as well, but which are never seen until the trees have been planted. Of course in a state where a large inspection force is active the number of chances for such stock to reach destination are reduced, but a number of states have not an inspection force sufficiently strong to keep close enough vigilance throughout the state.

Our inspection laws have no value in protecting us against our reliable nurserymen. We need no such protection. They will ship to us nothing but clean and sound stock. It is easy to see for whom these laws are made. Do they serve that purpose sufficiently well?

The writer, with the view of overcoming this difficulty, has for some time advocated the establishment of receiving stations for nursery stock within this state. Such stations may be located in convenient sections and a law passed that all stock coming into the state be shipped to one or another of these stations where the inspector has an opportunity to inspect the same. At any rate the inspection office would then have a method by which stock coming into this state could be checked and recorded.

Under what conditions would such stations be constitutional and would they be practical? The first is a question to be answered by the courts. The writer believes that under certain conditions as those described below that such stations could be economically and efficiently operated. Take South Carolina for example. The main office is at Clemson College in the northwestern part of the state. One entomological field laboratory is located at Marion in the eastern part of the state, another laboratory operating part of the time near Charleston in the southern part of the state. While the second field laboratory is not permanent, it is hoped to make it so. We would then have three convenient locations for such stations.

The amount of nursery stock shipped into South Carolina is not overwhelming and with the present amount of interstate trade, it

would not be very difficult to handle them at such receiving stations. Even where a tremendous amount of stock is shipped into the state, it would not always be necessary to handle every shipment. The inspection office makes as close a study as possible of all outside nurseries, doing business in the state, and these offices are generally well informed as to the reliability of the various nurseries. This information is a very convenient guide in handling interstate shipments. Instead of establishing quarantine stations, were the law amended so that every citizen would be required to notify the state inspection office every time a shipment of nursery stock had arrived, the visiting of the different places throughout the year would no doubt involve a greater expense and loss of time than a system of receiving stations where all stock is systematically inspected. The former would necessitate the employment of county or district inspectors in order to carry it out effectively.

These are merely suggestions. It is difficult to foretell what the efficiency of such a system would be without carrying out the experiment. These suggestions are not intended to burden our reliable and conscientious nurserymen but they are intended for all unscrupulous nursery dealers.

RESULTS OF EXPERIMENTS ON DIPPING TREES AND FUMIGATING PEACH BUDS

By T. B. Symons and E. N. Cory, *College Park, Md.*

[Withdrawn for publication elsewhere.]

Mr. Headlee: I wish to say that in connection with our work against mill insects, extended tests made to determine the formula, which would give the maximum amount of gas in the minimum time, indicated that the one now recommended by the Department of Agriculture (1–1–3) is best.

THE HEALTH OF PLANTS AS RELATED TO INSECTS

By J. B. S. Norton, *College Park, Md.*

The influence of insects upon plant health is enormous, as is witnessed by the great expenditure of time and money on economic entomology which is devoted mostly to protecting plants against this division of the animal kingdom. In this land of specialization the development of this branch of plant pathology by men specially interested in the insect has, as in the branch of fungous diseases developed

by mycologists, led away from the disease itself to the more thorough study of the causative organisms.

I wish to consider in the following paper the effect of insects upon the plant rather from the standpoint of plant health, than from the standpoint of the insect or of the entomologist, and in my judgment this would be the true attitude of the economic entomologist who wished to build his science upon the firmest foundation.

The action of insects upon plants may (1) directly impair the health of the plants, and may be considered under the head of (1) simple injuries, and (2) definite diseases which follow as a result of insect injuries or the presence of insects or their products in the plant tissues; or their action may be (2) indirect in that they actually introduce fungi or bacteria which cause disease, or these organisms may enter through the openings in the epidermis made by insects.

I. Direct Injuries

The chief effect of insects is the actual destruction of plant parts in the process of feeding, nest building or oviposition. While the loss of many organs is not so serious as with animals, owing to the great number of structures having the same function in most plants, growth and production is greatly reduced by the enormous losses on the whole, as, for example, in the reduction of carbon assimilating surface when such insects as army worms and other caterpillars, potato bugs, grasshoppers, etc., feed upon the foliage. Reproduction is interfered with through seed destruction by such insects as grain weevils, Angumois grain moth, wire worm, wheat midge; the embryo may be actually destroyed or the stored food removed so its growth is impaired. Reproduction is also interfered with at an earlier stage by insects such as the corn worm when feeding upon the silks and pollen. While codling moth and cotton boll-weevil interfere some with the reproductive organs, they are chiefly feared for the havoc they work to products of more use to man than to the plant.

Another form of injury is where the material for growth is removed by insects which suck out the plant juices, and while more serious trouble may occur at the point of attack the chief loss is in building material. The removal of material from the wood of stem or root may interfere with the mechanical stability of the plant and it breaks or is uprooted.

Physiological Troubles Following Injury

When plant roots or the woody stems have been destroyed by insects, wilting may follow from inability to secure water (*e. g.*, squash bug, bean vine borer, striped cucumber beetle) or if the damage is not

severe, a slow death indicated by red or yellow, stunted foliage and finally drying up of the leaf edges or whole leaf, due to reduction in water supply and salts from the soil. In cabbage lack of water stimulates the production of the bluish white bloom on the leaves which protects the leaf against loss of water; so this symptom may indicate root or stem injury by insects. Another means of protection against loss of water when roots are injured is for the plant to drop some of the leaves; and so leaf fall in summer may be a result of insect injury to the wood of stem or root.

In case the live bark is injured so that the plant is partly girdled, the downward flow of sap is interfered with and the parts below the wound may suffer for food while a swelling may form above where the nutrient material accumulates. The work of the bean vine borer is an example. A very interesting and well-illustrated account of interference with starch translocation from leaves, due to the work of leaf miners, has recently been published. (Centralb. Bakt. II, 24: 158.)

The destruction of the buds of plants by insects induces the production of branches out of the normal position and number and thus changes the habit of the plant, as in the case of plant bug injuries to dahlias, when there is a mass of leaves, roots and stems but no flowers, and the dwarfed greenish heads of wheat at the time they should be in bloom, due to another insect. I might class with these the scrubby growth of some pines, due to bud injury, and the crooked white pine trunks due to weevil borings; also the bending of the bean stem following work of the vine borer, and the curling of many leaves due to injury by insects on one side. Gummosis in peach and related trees follows the work of insects as it does any injury.

A serious trouble following defoliation by insects is the weakening of trees by the production of new crops of leaves to take the place of those lost. According to Britton two defoliations of elms in one season by the elm beetle will kill the trees.

Diseases Due to the Presence of Insects or Their Products

Under this head would come the multitude of galls formed by many different kinds of insects. But cecidology is a science in itself and having been studied more than some other branches of my subject I shall not go into it further. Whether insect presence stimulates the plant to excessive growth in gall formation I shall not attempt to say. A common example is woolly aphis galls, and erineum effect. Nematode root galls may be mentioned though hardly to be included among insect work.

I shall mention here some other troubles for want of knowledge to properly classify them anywhere: The darker green color, swelling at point of attack, and tendency to stool in wheat attacked by Hessian fly; the swelling and russeting of apples following the work of curculio; the suck fly injury to tobacco, which impairs its burning quality; leaf curl, due to leaf hoppers and thrips; stigmonose; red spots, due to San José scale, etc.

II. Diseases Indirectly Due to Insects

A large number of bacteria and fungi which induce disease in plants can enter the plant only through breaks in the protecting epidermis or bark. The large majority of such diseases enter through insect injuries, in many cases the insects actually carrying the infection on their mouth-parts.

Lindau, in volume two of the third edition of Sorauer's Pflanzenkrankheiten, gives references to the following diseases introduced by insects and other invertebrates:

Vuillemin believes the bacillus of the knot disease of *Pinus halepensis* to be introduced by insects.

The bacterial rot of hyacinths, etc., studied by Erwin Smith and Wakker, may be introduced through wounds made by insects.

It may be that some of the scab of potato is caused by *Euchutrœids* (*Oligochœtœ*) eating the surface of the tuber and the scab fungus afterwards occupying the injured surface.

Erwin Smith infected crucifiers with black rot by allowing *Agriolimax agrestis* to feed on leaves after being placed on pure cultures of the *Pseudomonas.* The larva of the cabbage butterfly is probably one of the chief means of introducing the bacteria in the field.

Waite has shown that the bacillus of pear blight is carried to the stigma, where the great majority of cases originate, from infected sap escaping from the bark in spring. The cases of blight on flowerless twigs may be introduced through insect punctures in the young bark.

Vuillemin thinks that the olive knot bacillus enters through the work of *Phytoptus fraxini* on ash trees.

The bacillus of potato rot is thought to be introduced by insects. Erwin Smith infected plants with *Bacillus solanacearum* by means of the Colorado beetle.

Earle considered the bacteria of point-rot of tomato to be introduced through small insect punctures and insecticides a better means of controlling the disease than fungicides.

Erwin Smith infected cucurbits with *Bacillus tracheiphilus,* the cause of wilt disease, by means of *Diabrotica vittata* and *Anasa tristis*

sprayed with the bacteria, and the destruction of these insects is recommended as a combative measure.

Rudow holds the infection of Prunus with Exoascus to be favored by the development of the fungus in the sugary secretion of plant lice.

J. Behrens thinks that insects carry the spores of *Nectria cinnabarina*. He noted that flies visited the fungus.

Descours Desacres observed that *Nectria ditissima*, associated with the canker of fruit trees in Europe, entered through the openings made by aphids, the same insect also transmitting the spores from one tree to another.

Noack observed that *Ophionectria coccicola*, a fungus living on scale insects in Florida and elsewhere, passed from the insect into the orange twigs and there caused a gummosis.

In the Sphacelia stage of the ergots a honey-like substance filled with the spores is produced. This is sought by *Melanostoma mellina*, *Rhagonycha fulva* and other insects, according to R. Stager, and by them introduced into young grass flowers.

A disease of sugar cane due to Trichosphæria studied by Massee, Prilleaux and Delacroix enters through the openings made by a beetle, *Xyleborus perforans*, the moth borer and the weevil borer, *Sphenophorus sericeus*.

Von Schrenk found that the wound parasite fungus *Ceratostomella pilifera*, causing the bluing of the wood of *Pinus ponderosa* entered through the borings of *Dendroctonus ponderosæ*.

A *Cucurbitaria* disease of trees is carried by snails that feed upon the stroma of the fungus.

In discussing the larch canker caused by *Dasyscypha*, a strictly wound parasite, Hartig mentions wounds made by *Coleophora laricella* and *Chermes laricis* as offering an entrance for the fungus. Also *Dasyscypha resinaria* enters spruce through the work of *Chermes abietis*.

The conidia of *Sclerotinia urnula* are carried to the flowers, of *Vaccinium vitis-idæa* by insects attracted by their fragrant smell according to Woronin. The same is true of other sclerotinias.

The sclerotinia of the brown rot of peach, etc., enters chiefly through the punctures of insects [chiefly curculio here].

The spores of smuts like *Ustilago violacea* which take the place of pollen in the anthers of flowers they attack may be carried from flower to flower by insects just as the pollen is.

According to von Schrenk the white rot fungus, *Fomes juniperinus* enters the red cedar through openings made by beetles.

The Phoma disease of cabbage is said to enter through wounded roots and insects are suspected. *Anthomyia brassicæ* is mentioned.

Macrophoma dalmatica probably attacks the olive through insect punctures.

The case of the mulberry disease caused by *Septoglœum mori* may be cited as an example of a plant disease with bad effect upon insects, as the diseased leaves are not used by the silkworms.

Botryosporium pulchrum attacks wheat weakened by *Tylenchus vastatrix* or otherwise.

Fusarium dianthi, according to Delacroix attacks Dianthus through wounds caused by mites, etc.

In addition I may mention the introduction of brown rot, black rot and other fungi into apples through codling moth injury; the decay of corn roots following the work of the corn root web worm mentioned by Sanderson; the rots of corn which are thought by Haslam to be the cause of blind staggers in horses and which enter through the injuries of the ear worm in the young ears; the entrance of early blight of potato through the flea beetle perforations.

In my work in 1896 on corn smut I found in testing different methods of infection, that puncturing of the young tissues after the beginning of ear and tassel formation was the most effective. Hitchcock later noted the increased amount of smut on detasseled corn. I am confident that under natural conditions the corn stalk borer will be found one of the chief agencies in corn smut infection.

The honey dew of plant lice and various scale insects furnish a medium for the growth of black fungi, which, while not parasitic, do damage by excluding light and air when they densely cover the foliage.

The flower-like fragrance of the spermogonia of rusts is attractive to insects and the spermatia are undoubtedly disseminated by them, but as this type of spore has but rarely been germinated, it is not known whether they may cause infection or not.

According to B. R. Bones of Racine, Wis., the cabbage rot germs are introduced by insects.

When the regular program had been disposed of, the following questions were taken up in order and discussed freely by the members:

QUESTIONS FOR DISCUSSION

1. The kind and form of information concerning individual nurseries to be furnished by an inspector to inspectors of other States.

2. What is the opinion of State inspectors regarding the sale of strawberry plants from districts known to be infested with the Strawberry Root Louse?

3. What is the best way to treat nursery stock infested with the San José Scale where such stock is to be planted in infested orchards or sections, the owners of which do not regard San José Scale infestation serious, they having adopted adequate spraying methods for its control?

4. Assuming that nurserymen may demand that their trees shall be treated for San José Scale instead of being destroyed, what formula for treatment should be employed?

5. Why does fumigation with Hydrocyanic Acid gas occasionally fail?

6. Will dipping nursery trees in lime-sulfur solution prove effective? If so, should roots be immersed?

7. What action should be taken by Horticultural Inspectors in reference to imported bulbs, herbaceous and greenhouse plants?

8. What progress has been made in barring wormy and scale infested fruits from the markets in different states?

9. Is it advisable to place upon the face of each certificate the number of acres represented?

10. Should not inspection of imported stock be made at ports of entry into this country, under federal supervision?

11. What is the best means within our reach to make sure that railroad companies are observing the law regarding the transportation of nursery stock without inspection certificate?

12. What is the present status of Crown Gall on Apple?
   a. Relation of Crown Gall and Hairy Root.
   b. Prevention of this disease in the nursery.
   c. Inspection and requirements for Crown Gall.
   d. Contagiousness.

The meeting stood adjourned at 5 p. m., Friday, December 30.

Another Breeding-place for the House-fly.—The material in which the House-fly is known to breed in greatest numbers is fresh horse-manure. But there are other substances which offer conditions of temperature and moisture that are as favorable, if not more so, and their scarcity alone prevents them being more than local factors in considering the control of this pest.

The writer made some observations on the breeding habits of the House-fly during September and October of 1910. Large amounts of alfalfa ensilage were being fed at the Kansas State Agricultural College dairy and what was not eaten by the cows was removed from the manger when cleaning the barn each day, and thrown into a manure spreader where it was left until a load had accumulated. Flies collected upon this waste ensilage in large numbers, and upon examination large masses of eggs—hundreds in a cluster—were found from one to two inches below the surface of the heap. A number of flies that were coming up from among the pieces of ensilage were caught, and they proved to be *Musca domestica.*

At first it was believed that the flies were attracted to the ensilage because it had been used as bedding and had become soaked with urine; but both eggs and maggots were found on chunks left in the manger from the last feeding. This led to an examination of the ensilage in the silo. Here the adult flies were numerous, and all stages of their life history were present. A handful of ensilage that the men in charge pronounced in excellent feeding condition was found to contain eggs and young larvæ. At the sides of the silo where decomposition had gone farther and the surface layers had not been removed so rapidly, grown larvæ and pupa were found.

Francis B. Milliken, B. S.,
Assistant Entomologist, Kansas State Experiment Station.

A NEW SPECIES OF COCCOPHAGUS WITH A TABLE OF THE HOST RELATIONS OF THOSE SPECIES OF THE GENUS KNOWN TO THE WRITER

By L. O. Howard

Coccophagus is a widespread and important internal parasite of certain scale-insects, and is practically confined to the non-Diaspinæ. Were it not for some of the extraordinary results of rearings carried on at the parasite laboratory at Melrose Highlands under the direction of Mr. W. F. Fiske and of others at the boll-weevil laboratory at Dallas under the direction of Mr. W. D. Hunter, I would state that the species of this genus are invariably primary parasites, but such statements as this in the light of these recent investigations must be more guarded. The probabilities, however, point towards invariable primary parasitism. The present species under consideration is the largest of the genus so far described and is quite distinct from its congeners.

Subfamily Aphelininæ Howard

Genus Coccophagus Westwood

Coccophagus albicoxa, n. sp. *Female.*—Length 2.6 mm., expanse 5.4 mm., greatest width of forewings 0.6 mm. General color shining black; apical half of mesoscutellum lemon-yellow with a central shade of the black descending somewhat into the yellow; all femora black; front and middle coxæ black, hind coxæ yellowish white; edge of metapleurum caudad of spiracle yellow; middle and hind tibiæ black, front tibiæ only dusky; front tarsi brownish; middle and hind tarsi light yellow; antennæ black, tip of pedicel brown. Mesonotum very faintly shagreened. Apical bristles of mesoscutellum very long; mesopleurum perfectly smooth, shining; abdomen smooth, shining, very faintly shagreened, much more faintly than mesonotum; wing veins dark brown; wings hyaline, iridescent. One female reared by H. J. Quayle from *Physokermes insignicola* received from Lampoc, California.

U. S. N. M. Type No. 12170.

The following table indicates the host relations of such species of the genus as are known to the writer:

Parasites	*Hosts*
Coccophagus lecanii Fitch	Lecanium quercitronis Fitch
	Lecanium quercifex Fitch
	Pulvinaria innumerabilis Rathv.
	Pulvinaria acericola (Walsh & Riley)
	Lecanium pruinosum Coq.
	Lecanium persicæ (Fab.)
	Lecanium on plum
	Phenacoccus aceris (Sign.)
	Coccus hesperidum Linn.
Coccophagus fraternus How.	Lecanium persicæ Fab.

Coccophagus cognatus How.	Coccus hesperidum Linn.
	Saissetia nigra (Nietn.)
	Lecanium sp. on plum
	Lecanium persicæ Fab.
Coccophagus immaculatus How.	Eriococcus azaleæ Comst.
	Pulvinaria bigeloviæ Ckll.
	Saissetia hemisphærica (Targ.)
Coccophagus flavifrons How.	Lecanium sp. on Pinus australis
Coccophagus flavoscutellum Ashm.	Coccus hesperidum Linn.
	Lecanium spp. from California
	Pseudococcus destructor Comst.
	Ceroplastes floridensis Comst.
	Lecanium tulipiferæ Cook.
	Pulvinaria on plum
	Pulvinaria on Sullengia
	Pulvinaria innumerabilis Rathv.
	Lecanium on plum
	Lecanium sp. on Adenostoma
	Lecanium sp. on Arctostaphylos
Coccophagus californicus How.	Lecanium armeniacum Craw.
	Icerya purchasi Mask.
Coccophagus lunulatus How.	Chrysomphalus aurantii (Mask.)
	Coccus hesperidum Linn.
	Saissetia oleæ (Bern.)
Coccophagus scutatus How.	Kermes sp. on Quercus agrifolia
	Kermes nigropunctatus Ehrh. & Ckll.
Coccophagus ochraceus How.	Lecanium sp. on Adenostoma fasciculatum
Coccophagus orientalis How.	Ceroplastes actiniformis Green
	Coccus viridis (Green)
	Saissetia hemispherica (Targ.)
	Pseudococcus longispinus Targ.
Coccophagus flavescens How.	Saissetia hemisphærica (Targ.)
Coccophagus fletcheri How.	Eulecanium fletcheri (Ckll.)
Coccophagus singuliventris Girault	Lecanium nigrofasciatum Perg.
Coccophagus subochraceus How.	Lecanium on Leucospermum
Coccophagus longifasciatus How.	Lecanium nigra (Nietn.)
Coccophagus howardi Masi	Philippia oleæ
	Ceroplastes rusci
Coccophagus niger Masi	Lichtensia viburni
Coccophagus albicoxa How.	Physokermes insignicola (Craw.)

The Rufous Scale at Key West, Florida.—In August, 1909, the writer collected citrus leaves at Key West, Florida, infested with a scale which, from a casual examination, was taken to be the California Red Scale (*Chrysomphalus aurantii* Mask.). Recently in looking over this material it was found that the insect is the Rufous-Scale (*Selenaspidus articulatus* Morg.). This citrus pest apparently has not been recorded heretofore from the United States. In the report of the Florida Agricultural Experiment Station for the fiscal year ending June 30, 1907, Dr. E. W. Berger presents a good half-tone illustration of a leaf infested by this insect and notes that it was sent to him for identification from St. Croix, Danish West Indies.

A. W. Morrill.

ATTITUDE OF THE NURSERYMAN TOWARD A NATIONAL INSPECTION AND QUARANTINE LAW

For the last fourteen years a strong effort has been made to secure national quarantine and inspection legislation, relating to imported plant stock. This effort has been blocked very largely by the opposition of a small body of importing nurserymen. The main body of nurserymen have interests identical with fruit growers, and seem to be generally in favor of protective legislation, and the *National Nurseryman,* the principal organ of the nurserymen in this country, has taken positive stand in favor of such legislation.

To obtain immediate legislation, to give the protection which is so much needed just now, it was agreed to modify the bill before Congress (H. R. 26897), to meet the final objection of the importing nurserymen, inasmuch as at the conference last winter with the House Committee on Agriculture, these nurserymen, through Mr. Pitkin, the chairman of their committee expressly stated that if their objections were met, they would join with the entomologists and fruit growers in urging the passage of this measure. It was arranged, therefore, that the quarantine provision of section 8 should be modified to apply specifically and solely to the "potato wart disease" which is likely to jeopardize our whole potato industry, and the "white pine blister rust" the European disease, which is the cause of great losses wherever it appears. Thus modified, the section does not touch the interests of the importers of nursery seedlings of fruit and ornamental stock, and it was confidently hoped and expected that the bill would become a law at the session just closed.

To get action at this session of Congress, it was necessary to bring the bill out of its regular order and place it on the Unanimous Consent Calendar, where the objection of one member prevents legislation. The Nursery bill came up on the 6th of February, and was objected to by a member apparently acting in behalf of the importing nurserymen, and went back to the regular calendar.

In the closing days of the session, the bill was again brought up on the Unanimous Consent Calendar. There was a brief discussion of it, chiefly participated in by the opponents of the measure and the motion to suspend the rules, and pass the bill was lost, the necessary two thirds not voting therefor, evidently largely through lack of appreciation by the house as a whole of the urgent need of the measure. (See *Congressional Record,* March 2, 1911, pages 4072–4076.)

This action of the nurserymen through their representatives in Congress is in exact accord with the previous behavior, as the following historical summary indicates. This summary is also interesting

as showing, through the reports obtained by Mr. Harrison, the actual attitude of the great body of nurserymen, other than importers, throughout the country.

Attitude of the Nurseryman as Shown by the Records

Numerous conferences, beginning in 1897, and ending in 1908, failed to secure any agreement with the nurserymen as to a national law, covering either (1) the inspection of home-grown nursery stock which becomes the subject of interstate commerce, or (2) the inspection of nursery stock imported from foreign countries.

The final report of the nurserymen is to the effect that the Nurserymen's Association refused to entertain any further consideration of a national inspection law, or to endorse any efforts toward securing one. (JOURNAL OF ECONOMIC ENTOMOLOGY, August, 1908, Vol. 1, pages 270–273). The association did, however, indorse thorough inspection of imported nursery stock at final destination of latter. This report is signed by Orlando Harrison, a prominent Maryland nurseryman, as chairman of the committee on national inspection law.

Mr. Harrison reports, however (*l. c.*, p. 271), sending out 460 letters in May, 1908, chiefly to nurserymen throughout the country, inquiring their wishes as to the enactment of a national law governing the inspection of both imported and home-grown stock. Two hundred and twenty-five replies were received, of which from nurserymen, one hundred and seventy were in favor of a national law, twelve against, and five neutral. Of the entomologists and inspectors of different states, out of thirty-three replies, only two opposed. This is interesting as showing the general attitude of nurserymen of this country. The objecting nurserymen, however, seemed to be the influential members, and were able to shelve any possible recommendations looking toward legislation. Furthermore, the resolution at the convention of nurserymen that year (June 10–13, 1908), indorsing the passage of a law by Congress providing for government inspection of all *imported* nursery stock, was shelved by reference to Mr. Pitkin of New York, chairman of the committee on national legislation, who made no further report on it. It may be noted that Mr. Pitkin and his conferees in New York are leading importers, and have persistently opposed such legislation as will be indicated later. This was the end of the attempt to secure legislation which had been under way since 1897.

The further attitude of the legislative committee, under the chairmanship of Mr. Pitkin of New York, is shown by the following records: With the renewed effort to obtain legislation in 1909, caused by the

discovery that the brown-tail moth nests were being brought into this country in enormous numbers on imported nursery stock, the legislative committee of the nurserymen, under the chairmanship of Mr. Pitkin, came to Washington to oppose the bill which had already passed the house and was before the senate for consideration, and would undoubtedly have become a law in due course. The committee made representation that it was not opposed to such legislation, but wished to have the bill amended in certain features to make it meet the needs of the importers of nursery stock. Under the supposition of an honest intention on the part of the committee, to this effect, the chairmen of the Agricultural Committees of the house and senate, respectively, consented to withdraw the bill for such amendment, with the idea that it would be submitted for enactment before the next session of Congress.

The actual attitude of this same committee is shown by the report of the committee, published in the *National Nurseryman*, for July, 1909, page 209. Chairman Pitkin says, "The chairman of the committee called to his assistance Messrs. Irving Rouse, James M. Pitkin, J. H. Dayton, Abner Hoopes, W. H. Moon, and Thomas B. Meehan, and the committee went to Washington and succeeded in *killing* the measure for the last session of Congress." A draft of a measure suitable to the nurserymen was submitted (same publication, pages 212–213). This draft is based on the "killed" measure, but the latter is so emasculated as to very much decrease its usefulness. For example, the substituted bill proposed by the Committee of the American Association of Nurserymen omitted (1) inspection in the country from which the importation is made, (2) the indication of the country or district in which the stock is grown, (3) provision making fumigation or inspection at the expense of the owner or consignee, (4) the provision for placing under quarantine, so far as any particular kind of plant is concerned, any foreign district where such plant is known to be infected with a dangerous insect pest or plant disease, not now in this country, and, (5) other sections weakened by the omission of necessary certificates and a penalty for counterfeiting or willfully altering same.

With the taking up of the subject of this legislation in the succeeding session of Congress, the same committee of nurserymen was called before the House Committee on Agriculture at Washington, in April, 1910, and a full hearing was given on the measure, nurserymen, state entomologists, and individuals representing agricultural and horticultural societies appearing before the committee. The chairman of the nurserymen's committee, Mr. Pitkin, stated in the published hearings of the committee (p. 75): "I am glad

to say, however, that we have not come down here to antagonize the principle of inspection and control. I am glad to see from this discussion that we are united upon the principles for which this bill stands. We have a little difference of opinion as to the best methods to be pursued, and these I believe are honest differences of opinion, and we ought to be able to get together"; and he continues in the same vein.

This sounds fair enough, but in his signed report with other members of the committee, published in the *National Nurseryman* for May, 1910, page 598, he says: "A hearing was granted by the House Committee on Agriculture at Washington on April 27 and 28, and your committee appeared at the hearing and made the strongest argument possible, first against the bill; second, suggesting some amendments and modifications if it were determined by the committee (House Committee on Agriculture) that some legislation is necessary."

It is evident that this nurserymen's committee, in spite of its fair promises, is first and foremost *against* legislation. In its report, referred to above, this committee advises every nurseryman in the country to immediately write to the Committee on Agriculture, protesting "in the strongest terms against the adoption by this committee of House Bill 23252, on the special ground that the power and authority granted by section 8 is liable to create abuses, and that the nursery interests in the country do not feel safe in placing in the hands of any federal official, such absolute control over the seedlings, the raw material of the nurseryman, from which fruit trees are produced."

The final action of the importing nurserymen, referred to in the introduction, blocked legislation at this session, notwithstanding that section 8 of the bill was to have been modified to meet the objections voiced in the last paragraph. This completes the chapter of the attitude of these importers, and presents the picture of this small commercial interest, for the moment checking legislation which is bound to come, and which will in the end be just as useful to nurserymen as it will be to fruit growers and forestry interests.

Published by the Legislative Committee of the American Association of Economic Entomologists.

T. B. Symons,
State Entomologist, Maryland.

J. B. Smith,
State Entomologist, New Jersey.

E. L. Worsham,
State Entomologist, Georgia.

TREATING SEED CORN FOR WIREWORMS

By H. T. Fernald, *Amherst, Mass.*

A previous number of this Journal (II, No. 4, 279, 1909) contained a note referring to experiments for the purpose of protecting seed corn from wireworms. In that note it was stated that the tests had progressed to a point where it seemed desirable to repeat them on a larger scale, and in different parts of the country.

During the past year, reports of quite a number of these tests have reached the writer, and have indicated a wide difference in the results obtained, some reports being very favorable, while others condemn the method in the most unqualified terms. To reconcile, if possible, these results, considerable correspondence has been necessary, but the final outcome has suggested certain factors as being responsible where failure was reported, and these are here considered.

In all the cases where the treatment was reported as unsuccessful, the failure of the seed to germinate was the nature of the complaint. This seems to have been caused by one of several reasons. Some experimenters appear to have used coal tar instead of gas tar, which may have been the cause. At Amherst, gas tar from the town gas works was the material used. In other cases, the tar was applied without thinning, and thus probably coated the seed with a layer so thick and impervious to water that it was impossible for germination to occur. In the original experiments the tar was mixed with linseed oil until it was quite thin, and under these conditions, all the seeds germinated.

Some experimenters apparently coated the tarred seed with Paris green unmixed with road dust, or any other diluent. While this would probably have no effect upon the germination of the seed, it is, at least, evidence that complaints which come from persons who do not follow directions, may be the result of failure in any of a number of points besides the one or ones actually ascertained.

On the whole, the method suggested can hardly be considered a failure, in spite of the criticisms it has received, until further tests, following the correct method, shall have demonstrated its worthlessness.

During the past season a modification of the above method has been tried with some success. Mr. R. D. Gilbert of the Bowker Insecticide Company, Mr. R. H. Whitcomb on whose farm and by whom the experiments were conducted, and the writer were all concerned in these tests, and desire to carry them further.

This method obviates the necessity of two treatments of the seed, first with tar and then with Paris green, by using a paste arsenate of lead. In the particular experiments here reported, Disparene

in paste form was used. This was first diluted to about the consistency of paint. The seed was then placed in this and stirred about till thoroughly covered, then spread out to dry before being planted.

Unfortunately the wireworms were not so abundant in the fields planted, as to give an entirely satisfactory test, though some were present. The germination of the corn treated in this way was all which could be desired; none of it was attacked by the wireworms which were present, and a good stand of corn was obtained. It would now seem desirable to test this method where wireworms are very abundant, to ascertain just how effective it is against these pests, and it is planned to do this the present year if infested fields can be obtained. It is desirable, also, to repeat these tests in other parts of the country, and this article is published now in the hope that the method will be tested in many places, and the writer will be glad to learn of results, from which final conclusions as to the value of this treatment can be drawn.

NOTES ON SOME INSECTS INJURIOUS IN NEBRASKA IN 1910

By Myron H. Swenk, *Lincoln, Nebraska*

During the past season several cases of insect injury to field crops of a severe or unusual character have engaged the attention of the Nebraska entomologists, some of which will possibly be worth recording. Among these was the yellowing and dying out, frequently to a distinctly serious extent, of the winter wheat during latter October, 1910, in eastern Nebraska, due to the attack of wheat-root aphids. This injury was not confined to a limited region, but covered the territory south of the Platte west to Buffalo and Kearney counties and northward about to Burt County, thus including most of the wheat-growing area in the state. Although the impression prevailed that the Hessian fly was chiefly responsible for this discoloration and dying out of the wheat, and, in fact, that pest was seriously injurious in the early sown fields, our investigations showed that two other factors were also operating to produce this same effect and that in many fields these latter factors were the chief and perhaps the sole cause of injury. One of these was wheat-root aphids and the other was ordinary wheat rust in an unusually severe infestation.

In some fields two, or perhaps all three, of these factors were operating simultaneously, so that it became extremely difficult, if not impossible, to accurately determine just how much of the injury was due to each, but a goodly number of late sown fields showing no considerable number of Hessian fly puparia and not rusty or severely so

as the case happened to be, still were rapidly dying out and these showed great numbers of large plump aphids clustered about the lower stem and roots, draining the plant sap. These aphids were mostly *Geoica squamosa* and, less commonly, *Forda occidentalis*, both of which have previously been recorded as minor corn pests in Illinois. Dodge, Adams and Seward counties showed particularly obvious injury, and the injured fields were not concentrated, but were scattered throughout the whole affected region, being often several miles apart, with the intervening fields not noticeably affected by either the *Geoica* or the *Forda*, though *Siphocoryne avenæ* was commonly present in small numbers in all the fields. Taken as a whole the injury was rather extensive. It first became apparent in September when small patches began dying out, and these enlarged as the fall advanced and the aphids multiplied and spread, until they involved an acre or two in extent, and, not rarely, the entire field. The wheat in the affected patches was cleanly taken and the plants were dead to the roots. The aphids continued working until late in November undergoing some quite severe temperatures. Almost invariably both these wheat-root aphids are attended by the ant *Lasius niger neoniger*. We found the *Forda* during the past winter hibernating abundantly under stones near nests of the *Lasius* and feeding upon the heavy creeping rootstocks of a grass presumably quack grass (*Agropyron repens*), at Lincoln.

The present season has not been the first that these aphids have injured wheat, though it is by far the most extensive injury we have known. Our first definite knowledge of the injurious habits of these aphids was recorded in 1907, when during April of that year Mr. H. S. Smith found the *Forda* very abundant in the wheat fields of Buffalo, Kearney and Adams counties while he was investigating reported occurrences of the green bug in that region. Although some plants supported as high as forty aphids, the infested fields on the whole were not seriously injured. In the fall of that year, October 17, Mr. Smith found the *Geoica* attacking volunteer wheat scattered through the sowed grain in Hamilton County, it being quite abundant upon the roots and causing the plants to assume a sickly yellowish green color. In 1908 the *Geoica* appeared in excessive numbers in Clay County during middle October, one farmer reporting them to be present by the millions in his wheat fields. Last year (1909) the *Forda* injured fields in several localities in Hall County, killing out the wheat in patches an acre or two in extent between middle September and latter November, and similar reports were received from Boone County in October. The present season the *Geoica* greatly predominated, being first found in Hamilton County in July, in limited numbers on corn roots with *Aphis maidi-radicis* and abundantly on the grasses in the

corn fields and then later, during the fall, on wheat over a large area in the Platte valley as just detailed. These two root infesting aphids, then, have placed themselves on record as serious enemies of winter wheat in Nebraska.

Another, and I believe unrecorded, serious enemy of winter wheat came to our notice this fall from two separate localities, from Buffalo and Holt counties, in the form of a *Cyclocephala* white grub. This injury occurred in October, and the Buffalo County infestation was fully examined by the writer in person. The same condition was common in many fields in the southeastern part of the county, namely, that the plants had commenced dying about the first of September and in the next month had died out completely or at least had only a scattered sickly stand remaining. The soil in these fields was fairly alive with the *Cyclocephala* larvæ, as I turned over fifty in a space less than two feet square and did not secure all of them. Similar, though less intense, injury has been experienced in this region during the past three seasons. We do not yet know for certain the exact species concerned in this work, as we have two common species of which it might be either, namely, *C. villosa* and *C. immaculata*. *C. villosa* is, however, much the more prevalent in the infested area, and it is probably that species.

For the past three seasons at least (1908–10) there have been more or less serious local outbreaks in the wheat and oat fields of western Nebraska of a wheat-head army-worm allied to the common wheat head army-worm (*Heliophila albilinea*), to which species we referred it until recently when a careful study of the adults proved it to represent a distinct species not heretofore recognized as a field crop pest. Dr. J. B. Smith recently examined bred moths of the western Nebraska army worm and pronounced them to be *Heliophila limitata*, a species which he had described in 1902 from a single male specimen collected in Texas in June. In 1908 and, according to reports, in 1906 also, during middle July there were local outbreaks of this army-worm in the oat fields of Deuel County near Lewellen, and in some instances the worms practically destroyed the crop by clipping off the leaves from the stem and cutting off the heads of grain, there being on the average, about one worm to each head of grain. In 1909 several localities were affected by this army-worm, especially about Trenton, Hitchcock County, Wauneta, Chase County, and Alliance, Box Butte County, but the damage on the whole was not very severe. In middle July (6 to 17) about Trenton and Wauneta, when the wheat was harvested the stubble was found infested with myriads of these worms, some of which had been in evidence upon the heads a bit earlier in the season. About Alliance the trouble was more in the oat fields, and while har-

vesting in some fields the canvas of the binder would become covered with the worms whi'e the whole field was alive with them. The above instances of damage are recorded on the strength of examinations of the larvæ, which seem to be readily distinguishable from those of *albilinea,* except in the case of the Trenton insects where some of the 'arvæ were reared. The species seems probably double brooded like *albilinea,* for from larvæ received July 12 all pupated July 17 and moths emerged August 14 and September 1. Many, though not all, of the infested fields were in sod the preceding year.

The past season was the worst grasshopper year we have had for a decade in central and western Nebraska, and during July these insects were exceedingly destructive to the alfalfa, corn and oats of that section of the state. At Red Cloud, Webster County, in early August the prevailing species, *Melanoplus bivittatus*, was very heavily parasitized by an undetermined sarcophagid fly, which in turn was parasitized by the chalcid *Perilampus hyalinus*. The chinch-bug (*Blissus leucopterus*) was the most abundant in the southern counties this year that it has been since 1901 and during July injured wheat, oats and corn seriously. The corn-leaf aphis (*Aphis maidis*) this season was exceedingly abundant in Sherman County near Loup City during early August, and in some fields produced rather serious injury by killing the upper leaves, on which it had congregated by the thousands. A local outbreak of the green bug (*Toxoptera graminum*) occurred in late October near Shelby in Polk County and the wheat fields were found swarming with these aphids, but they were so heavily parasitized by the *Lysiphlebus* that no spring attack is anticipated.

SOME OLD METHODS APPLIED IN A NEW MANNER TO A COLLECTING MACHINE

By H. F. Wilson, *Oregon Agricultural College*

The included sketch illustrates a machine used by the author during the past spring for collecting hibernating insects. Jarring and heat are relied upon and a very large sifting surface is secured. Another advantage is found in the fact that the machine can be used as readily in the field as in the laboratory and without alcohol or kerosene. The bottom is flat and the machine can be set on a stove in the laboratory or placed over a trench in the field. When used in the field a piece of stovepipe should be used as a chimney in order to carry away the smoke and to keep a continuous draft under the tank.

The main box is made of galvanized iron and is 4 feet long, 2 feet high and 18 inches wide, the bottom piece being of one continuous piece soldered and riveted at the corners. This lessens the danger of melting the soldered connections. In the present case the box is braced with pieces of iron bed rails riveted around the bottom and along the corners, with a continuous band around the top; the band is of iron 1 inch x 3-16 inch. This makes a strong but light box and one person can handle it without much trouble.

The end E is made in two parts, the upper part being fastened to the lower with hinges, so that it can be lowered and ready access

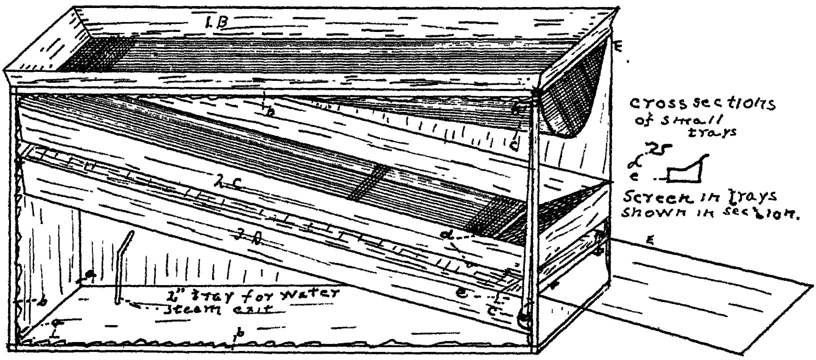


Fig. 6. Collecting machine; B. C. D, three trays; *a* upper line of the water tank; *b* iron supports of the box; *c* parts of the jarring arrangement; *d* and *e* cross trays and sections.

gained to the two lower trays. The water tank is of galvanized iron and is made in the form of an inverted tray soldered to the inside of the tank. This tray is two inches deep with an inlet hole in one corner and an iron tube connected to the outside whereby the steam is carried away.

At the end E a crank and sprocket wheels with a bicycle chain can be used to jar the trays by raising them and dropping them. At the bottom of the middle tray a round wooden piece with a raised side is run across the box and at every revolution of this piece the tray is raised and allowed to drop. The other two trays are fastened to this one and are raised and dropped at the same time, giving all of them a steady but light jar.

The top tray is made so that the ends and sides are parellel with the top and with the sides slanting inward so that the bottom of the tray is smaller than the top of the tray below. A piece is morticed in to the end and is allowed to drop about 11 inches below the end of the tray at the end E. From the other end of the tray another

piece is run to meet with that piece and around them 1-4 inch wire screen is fastened. We now have a tray that will hold about two sacks of leaves and with a sifting surface equal to nearly ten square feet.

The other two trays are made to run parallel with each other and slanting as much as possible in the remaining upright space. This should be from one inch from the top tray to within one inch of the water tank. These trays rest on a board which runs across the end of the box E and are supported at the other end by hooks which gives them a free movement for jarring. This cross board also acts as a base for them to fall upon when they are dropped by the turning of the jarring wheel.

Tray 2, as shown in the diagram, is made with two pieces of 1-8 inch wire screen. One piece running from the top of the upper edge to within 8 inches of the lower side at the bottom. The second piece runs from the top of the lower side to within an inch of the other piece and so leaves an open space of one inch running transversely across the box. A small tray of tin is fastened across this opening, the sides being rounded as shown in the illustration. The ends are of tin and are soldered so that the insects cannot escape, most forms being unable to crawl up the tin surface. This tray is fastened in place by reversible clamps and can be removed by lifting up the tray. The insects thus caught can be transferred to something else and the tray returned to its place with but little loss of time.

Tray 3 is made so that the carrying part is of tin, one inch deep, open at the lower end and overlapping a cross tray. The tin part is placed so that it is about even with the top of the carrying frame and reaches to within two inches of its lower end. At the bottom of the main tray a shelf is placed to hold a cross tray three inches wide which underlaps the main tin tray and catches all that falls into it. This tray is made to fit squarely into the wooden tray and can be removed by raising up the middle tray.

The lower cross tray will necessarily catch all the rubbish and small particles of sand that fall through the upper trays but the author was able to separate out the insects by gently pouring the contents of the tray into a tub of water. The sand and dirt would sink to the bottom while the insects would be held on the top film of water. To what extent this would apply it is hard to say as mites only were considered in our experience.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

Efficiency engineering is the application of scientific principles to ascertain the most economical method of accomplishing a given task. Economic entomologists have been from the very first, efficiency engineers in their own fields. Some of our mechanical and agricultural colleges may yet give the degree of E. E. E.—Efficiency Engineer in Entomology. The primary burden of the economic entomologist is to demonstrate possibility; next comes economy in execution. The symposium on spraying in this number is a notable contribution to this phase of efficiency engineering. The spraying apparatus of early days was planned for very different work and there was little adaptation to the special conditions obtaining in the field. A number can recall the hand outfits used in the ear'y days of the gipsy moth work. Compare them with the present high power outfits capable of spraying forest land for less than $7 an acre—a figure way below possibilities with hand labor. The ample power, heavy hose and solid stream nozzle represent a stage in the development of an efficient spraying outfit. No one dares to say the limit of efficiency has been reached. The solid stream, while well adapted to certain phases of woodland work, is open to serious criticisms. A considerable amount of poison is wasted even with the most skillful handling. The impossibility of closely controlling the applicationof the spray militates strongly against its general employment in shade tree work. A mechanical extension nozzle operated from the ground and capable of rapid and extensive modification in height, direction and character of spray, is an important desideratum. The unusually long extension nozzle on universal bearings, used in the roadside gipsy moth work, is a step in this direction. One manufacturer has put on the market a mechanical spray tower which needs testing out and probably some improvement. The

grandest field laboratory for the study of spray efficiency is to be found in the gipsy moth infested territory of eastern Massachusetts, with its hundreds of outfits of widely varying types. There is an excellent opportunity in this section for additional studies of spray efficiency. This is not to be construed as an implied criticism of the past with its admirable record of achievement, but a suggestion as to profitable lines of activity in the future.

There is another problem in woodland work deserving of serious consideration, since economy of treatment is perhaps the most vital factor in such an undertaking. There have not been to our knowledge, any careful studies as to the results which may by obtained from applications to portions of trees, aside, perhaps, from the data gained in an incidental way in the early days when it was impossible to spray the tops of tall trees. There is abundant evidence to show that a number of our leaf-feeding pests will destroy the tops of trees unless they are well protected by poison. We recall nothing that establishes the efficiency or relative inefficiency of applications to the foliage of only the upper portions of trees, a place where a number of our leaf feeders begin operations and one where it would seem that many might be destroyed with a minimum expenditure and before serious injury had been inflicted.

The recent action of Andrew Carnegie in placing at the disposal of the African Entomological Research Committee the sum of £1,000 for three years to defray the expenses of sending suitably qualified young men to the United States for the purpose of studying the practical applications of entomology is a gratifying recognition of the excellent work which has characterized American investigations. No country at the present time expends so much upon economic entomology as America, and nowhere can be found such a corps of experts. The enormous development in recent years has been the outcome of a greatly increased demand for protection from injurious insects. With a better understanding of the practicability of checking insect enemies, there will be progressive calls for more service. These can be met satisfactorily only by retaining in this branch of science the most able and original workers. Such, in the long run, can not afford to devote their entire energies to a field offering inadequate compensation. It is a lamentable fact that, despite the enormous growth in demand for entomological knowledge in the past few years, there have been very few increases in the number of really desirable positions, while a canvass of the situation would show that the recognized leaders in economic work are receiving very inadequate com-

pensation. The ultimate outcome of a continuance of such conditions is bound to result in deterioration, since many of the more progressive investigators will turn to fields with better promise of financial returns and affording equal opportunities from a scientific standpoint. Many admirably trained college graduates have taken up entomological work within the last decade, and several schools now have their resources taxed to the uttermost to meet the demand of those who desire to enter this field. Even with this additional supply of workers it is impossible to secure qualified assistants at prices which were considered ample ten years earlier. Many of these men with their years of experience in special work must soon find positions offering more than their present income, or entomology will lose some of its most capable students. This would not be serious if there were no need of their services; but the contrary is true. There is greater apparent and potential need today of practical knowledge relating to insects than was the case twenty years ago and the demand for such is bound to increase. This condition must be reflected in the opportunities of advancement both professionally and financially or retrogression is inevitable. The former must prevail. The latter is unworthy of a progressive nation dependent in large measure upon the prosperity of the agricultural interests.

Bulletin of Entomological Research.—The appointment in 1909 of an entomological research committee for tropical Africa augurs well for the future welfare of the Dark Continent, since it implies a more adequate recognition of the important part insects play in the dissemination of tropical infections. The representative committee upon which this burden was laid, proceeded at once to organize the work and, as one of the results of their activities, we have the above mentioned bulletin, the first number being issued about a year ago. This new publication naturally concerns itself largely with mosquitoes and Tsetse flies, species of which are among the most active and dangerous disease carriers, though an examination of the contents of the four issues shows that those responsible for this venture are taking a broad view of the situation. The original studies are not closely limited to species of known economic importance, but include allies and forms likely to be confused with the dangerous pests. Moreover, those affecting agricultural and other products valuable to man, are given due attention. The work is of necessity pioneer in nature and a large number of interesting species are bound to be discovered. We confidently expect that the systematic study of African entomology will result not only in large additions to knowledge, but in a material gain in information of immediate practical value. We take this opportunity of commending the auspicious beginning of what will undoubtedly prove to be a magnificent undertaking. There is great need of similar work in American tropics. A beginning has already been made though it can hardly be characterized as a systematic and comprehensive study of the problems involved.

E. P. FELT.

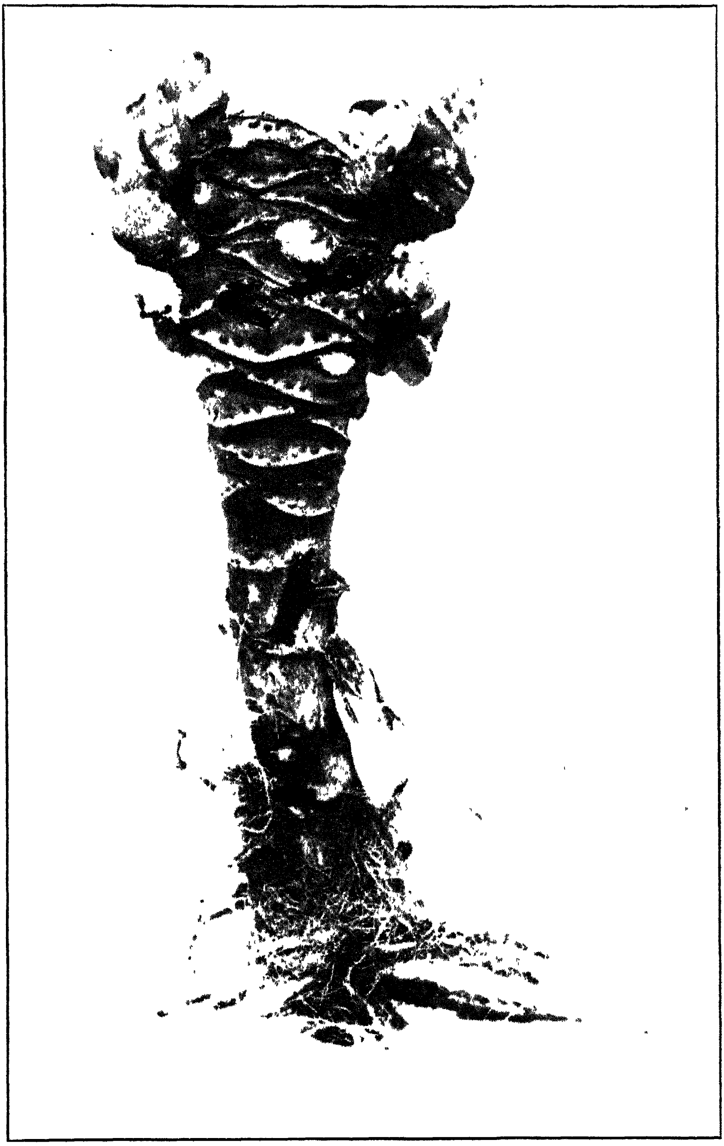
Reviews

The Grape Root-Worm, by FRED JOHNSON and A. G. HAMMAR. U. S. Dept. Agr., Bur. Ent. Bul. 89, p. 1–100, figures 31, plates 10. 1910.

This is another comprehensive bulletin based on the work of a series of years. The thorough biological studies summarized in a series of tables leaves little to be desired. Particular attention was given to the behavior of the insect from year to year, and the effect upon it of varying conditions. The life history of the egg parasite, *Fidiobia flavipes* Ashm. was carefully worked out and an unknown, supposedly dipterous egg parasite discovered. One of the most gratifying phases of the work was the obtaining of unquestioned evidence as to the value of thorough spraying with an arsenical poison for the control of this serious pest. Emphasis is laid upon the necessity of an early application so as to reach the beetles just after emerging from the soil, since they appear to feed much more freely at this time. A second spraying is advised 10 days after the first. The destruction of pupæ is recommended whenever conditions are favorable. The data relative to the renovation of badly injured vineyards is a practical phase which will appeal strongly to the grower. There is an extended bibliography. The effectiveness of the bulletin is greatly enhanced by an admirable series of illustrations. The authors are to be congratulated upon having made a substantial addition to our knowledge of a very destructive insect pest.

Life History of the Codling Moth in Northwestern Pennsylvania by A. G. Hammar. U. S. Dep't Agric., Bur. Ent., Bul. 80, Prt. 6, 1910, p. 69–111.

This contribution summarizes in very small compass the results of three years investigations of the codling moth at North East, Pa. Aside from the new facts submitted, entomologists will be interested in the illustrations of methods, such as the handy device for studying the duration of the pupal period and the outdoor shelter used in rearing work. Both may be of material service to investigators. The studies of the pupæ show that this stage may extend from fifteen to thirty-four days, the average being nearly twenty-two. Table VI shows that the moths emerge between 7 a. m. and 1.30 p. m., while the length of adult existence ranges from seventeen to nineteen days, the average being a little over eleven. The author concludes that the larvæ are frequently cannibals, since rarely more than one attains maturity in an apple, though observations show that a great number may enter the same fruit. A summarization indicates that transforming larvæ may feed from seventeen to thirty-seven days, an average of twenty-six and one-third days, while overwintering larvæ may extend their feeding time to fifty-five days with an average of a little over thirty-one days, approximately 70 per cent of the first brood hibernating. The exact data on the appearance of moths and the deposition of eggs will be of great value in determining the period when spraying can be done to best advantage. Overlapping of the broods and the various stages of each is graphically shown in figure 22 and illustrates the difficulty of laying down hard and fast rules for the control of this insect, particularly when it is remembered that there is more or less variation from year to year. The value of the bulletin is greatly increased by including therein local weather records during the growing season for the three years. The author has made a notable



Injuries by cabbage maggot in principal portion of cabbage stump.

addition to our knowledge of this pest and it is to be hoped that here we have only one of a series of local studies which should be made in representative sections of the country, not only of the codling moth, but also of other insect pests.

The One Spray Method in the Control of the Codling Moth and the Plum Curculio by A. L. Quaintance, E. L. Jenne, E. W. Scott and R. W. Braucher. U. S. Dep't Agric., Bur. Ent., Bul. 80, Prt. 7, 1910, p. 111–146.

The results given in this paper are exceedingly interesting, since they are the outcome of experiments conducted under the same general plan in widely separated sections of the country. Comparisons were made between one thorough application, under high pressure, of a bordeaux mixture poisoned with arsenate of lead, subsequent treatments being restricted to the application of fungicides, and demonstration spraying which consisted of five poison applications, all except the first being mist sprays. These two in turn were compared with unsprayed or check trees. The arrangement of the plots and location of the trees from which data were taken was not ideal, though the results do not appear do have been materially affected. The summary shows that so far as the control of the codling moth was concerned, there was not very much difference between one spraying and the demonstration treatment where approximately two thirds or more of the fruit on unsprayed trees were sound, the variation being only from 4 to over 5 per cent in favor of repeated spraying. On the other hand, there was considerable advantage in several applications of poison where only about half of the fruit on unsprayed trees was free from codling moth injury, the difference in their favor being approximately 10 per cent in one case and in the other instance only about 1 per cent. Being unacquainted with the reasons for this marked discrepancy in the latter instance and the authors throwing no light thereupon, we can only hazard the suggestion that the uneven character of the land as shown on Plate 10, figure 2, may have been a factor in reducing the efficiency of the treatment. There were in all sprayed plots, as was to be expected, substantial benefits resulting from the treatment. Such repeated applications are of comparatively little value in controlling plum curculio, as shown by the fact that in two plots sprayed but once there was a larger percentage of fruit free from injury by this insect, while the remaining two plots, receiving the demonstration treatment, were only slightly less affected than those sprayed but once. There was material, and in the case of one plot, a very great difference in favor of poisoned applications as compared with no treatment at all. The authors' results with the single spray against the codling moth agree in a general way with those secured by the reviewer. Obviously, there cannot be a material saving with one application of poison in sections where several treatments are necessary for the control of other insects or fungous diseases. It is a fact that certain of our fruit-growing sections, at least, are moderately free from insects which cannot be kept in check by thorough annual sprayings at the time when such treatment would be most effective in controlling the codling moth, and where there is little likelihood of serious trouble from fungous infection. These considerations justify an exhaustive study of the possibility of controlling insects and fungous diseases on fruit trees with one timely and thorough spraying.

Apple and Pear Membracids by H. E. Hodgkiss. N. Y. Agric. Exp't Sta. Techn. Bul. 17, 1910, p. 81–112.

This publication is a marked addition to our knowledge of four rather common species, one of which at least has been very frequently mentioned in economic litera-

ture. The life histories of *Ceresa bubalus* Fabr., *C. taurina* Fitch, *C. borealis* Fairm. and *Stictocephala inermis* Fabr. have been carefully worked out and the various immature stages fully described and admirably illustrated. The economic status of each species is discussed and the value of the publication materially increased by complete bibliographies.

First Report of Economic Biology by Walter E. Collinge. The Midland Educational Company, 1911, p. 1-74.

This report gives short, and, for the most part, illustrated notices of a considerable number of injurious species depredating upon farm and garden produce, fruit trees, forest and ornamental trees and those preying upon animals. There is in addition, one chapter discussing fungous diseases. The American entomologist will be particularly interested in the accounts of species established in America or likely to be brought to this country, such as the bulb mite, *Rhizoglyphus echinopus*, the bulb scale, *Ripersia terrestris*, besides such well-known pests as the pear midge, blister mite, etc. It is a pleasure to commend in particular the excellent process reproductions of admirable photographs.

Current Notes

Conducted by the Associate Editor

A fellowship has been established in Cornell University, College of Agriculture, for the investigation and control of the fungous diseases and insect pests of the orchard crops of Batavia, N. Y., by the fruit growers' association of Batavia, and provides for two fellows, one in entomology and one in plant pathology.

The work announced for the Lake Laboratory of the Ohio State University for the coming summer includes a course in entomology and the opportunity to conduct research work in problems upon insect life. The laboratory is at Cedar Point on Lake Erie in an exceptionally favorable locality. The entomological work will be in charge of Professor Osborn, Invertebrate Zoölogy under Professor Brookover and Ecology under Professor Jennings, all including matter which is of distinct interest to entomologists with the privilege of free tables to investigators. The session opens June 19, and additional information as to particular courses or the general announcement may be obtained upon application to the director.—Herbert Osborn, Ohio State University, Columbus, Ohio.

J. L. Phillips, formerly state entomologist of Virginia, with headquarters at Blacksburg, is now located at Staunton, Va., and has opened an office as consulting orchard expert.

Dr. Henry Skinner has been giving a course of lectures in the Ludwig Institute of the Academy of Natural Sciences, Philadelphia, Pa., covering the whole field of entomology, but emphasizing especially its medical aspects.

At the University of Colorado a State Biological Survey has been organized under a committee consisting of Professors T. D. A. Cockerell, Francis Ramaley and J. Henderson. An investigation will be made of the fossil and living plants and animals of the state.

Science states that according to Reuter's Agency the British South Africa Company has decided upon the despatch of a special commission to investigate sleeping sickness in Rhodesia. The commission will consist of Dr. Aylmer May, principal medical officer of northern Rhodesia; Dr. A. Kinghorn, of the Liverpool School of Tropical Medicine; Doctor Leach of the northern Rhodesia Medical Service; Mr. O. Silverlock, entomologist, and Mr. Jollyman, bacteriologist.

At the Oregon Agricultural College a Biological Club has recently been formed, the charter members consisting of the Bacteriology, Zoölogy, Entomology, Botany and Plant Pathology departments. The object of the organization is to promote interest in the various subjects, both systematic and economic, which will fall under the various departments.

The Oregon Legislature at its last session appropriated the annual sum of $15,000 for the purpose of investigation of crop pests. This fund is to be divided into three parts; the Entomology, Horticultural and Plant Pathology departments each receiving a third. This is for the purpose of carrying on experimental work upon all economic problems within the state, and is probably the first appropriation made in any state for such a purpose alone.

The people of the Hood River Valley, Ore., have entered upon a coöperative plan whereby an expert furnished by the college, but whose salary will be paid by the Hood River fruit growers, will be stationed at Hood River. The duties of the expert will be to investigate such insect pests and plant diseases as become injurious to the fruit orchards. This expert is Prof. W. H. Lawrence, formerly director of the Puyallup sub-station of the Washington Experiment Station.

Upwards of 150 students are at present enrolled in the various classes in entomology at the Agricultural and Mechanical College of Texas. This is the largest enrollment in the history of the department, and has been brought about both by the increased attendance at the college and the constantly increasing number of students taking up agricultural subjects. The teaching force of the department consists of Wilmon Newell, professor; E. E. Scholl, assistant professor, and Harper Dean, instructor.

The enrollment in entomology the present term at the University of California is 426. Eighteen different courses are offered during this semester. The largest classes are in general entomology, ecology, apiculture, medical entomology and spraying, showing that the purely economic subjects are given the preference by students.

Mr. J. C. Bridwell will spend the next six months in southern California, largely in the Imperial Valley, and Prof. H. J. Quayle, who has been assigned to investigation work the last three years at Whittier, has returned to Berkeley and resumed his class work.

Prof. E. W. Berger, entomologist of the Florida Agricultural Experiment Station, gave a talk, illustrated by lantern slides, before the American Pomological Society in session at Tampa, Fla., on the evening of February 10, 1911.

E. F. Hitchings, state entomologist of Maine, has been appointed professor of horticulture at the University of Maine, at Orono. He will continue to hold the position of state entomologist.

Mr. T. D. Urbahns, instructor in entomology at the Minnesota Agricultural College, has resigned to take up an investigation of the alfalfa weevil for the Bureau of Entomology, and will be located at Salt Lake City.

The January issue of *Agriculture*, published monthly by the Association of Agricultural Students of the University of Nebraska, is an entomological number which will doubtless prove of interest to many of our readers, since it gives a summary account of the development of the Department of Entomology, including a discussion of its present activities.

Mr. D. L. Van Dine has left the employ of the Sugar Planters' Association at San Juan, Porto Rico, and is now entomologist of the Estacion Experimental de Azucar, Rio Piedras, Porto Rico, where corresponsdents should address him.

The advance of the boll-weevil into Alabama, occurring during the fall of 1910, has already exerted a strong influence in leading planters to adopt more improved methods, not only in the culture of cotton, but with other crops as well. The press of the state has shown a most commendable desire to help in the campaign of progress and the leading papers are anxious to publish agricultural matter.

The Alabama Legislature, now in session, has been sufficiently impressed to appropriate $27,000 for 1911, and twice that amount for each of the succeeding three years for the enlargement of the Experiment Station work. This is the first direct appropriation that the state has made to the Experiment Station. With this general awakening, and the open-minded attitude of the planters and business men, Alabama stands some chance of suffering less from the advance of the boll-weevil than have most other states into which it has spread.

Miastor larvae. —These remarkably interesting larvæ reproduce by pedogenesis, are available for laboratory work to a marked degree and must be widely distributed as well as allied forms. Very little is known concerning American species, largely because their habitat is one rarely explored by entomologists. They breed mostly in decaying vegetable matter. We have been very successful in finding them under partially decayed chestnut bark of stumps, fence rails and sleepers which have been cut one or two years earlier. European species occur under the bark of a variety of trees and even in sugar beet residue. These Dipterous maggots with diverging antennæ and a fuscous ocular spot in the first body segment, have a flattened, triangular head quite different from the strongly convex, usually fuscous head of the Sciara larvæ occurring in a similar environment. They have a length of from one-twentieth to one-eighth of an inch and may be found in colonies containing a few large, white larvæ with numerous smaller, yellowish individuals, the latter being more common at the present time. Early spring with its abundance of moist bark appears to be the most favorable season for finding the larvæ. The writer would welcome the coöperation of entomologists and others in searching for these forms in different parts of the country. He will be pleased to determine specimens found under various conditions, make rearings therefrom if possible, and thus add to our knowledge of the subfamily Heteropezinæ, a group which should be fairly abundant in North America and one deserving careful study. E. P. FELT, *Albany, N. Y.*

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NOTE ON THE CORK-COLORED ORANGE TORTRICID[1]

Platynota rostrana Walker

By E. R. SASSCER, *Bu. Entom. Dept. Agric., Washington, D. C.*

The Cork-Colored Orange Tortricid was first described by Walker[2] in 1863 from material collected in the United States and St. Domingo and Ega Hubbard in "Insects Affecting the Orange" gives a brief account of this insect in which he states that it is injurious to nursery plants and occasionally damages the fruit by puncturing the rind. Although the larvæ of this insect frequently bore into the rind of citrus fruits, no observations have as yet been made which would indicate that they enter the fleshy part of the fruit. From time to time letters have been received by the Bureau of Entomology, relative to the appearance of this pest in various sections of the country, but in only a few instances have they been reported as doing serious damage.

In February, 1909, Mr. Edward Gottfried of Key Largo, Fla., submitted grape fruit infested with this insect and subsequently gave a report on the conditions as they existed in his grove. According to his estimate fully 15 per cent of the fruit was damaged by the larvæ of this tortricid. In March of the same year, Dr. L. A. Peck of Melbourne, Fla., reported this insect present in his grove, stating that he had observed the punctures made by this pest for a number of years but had not hitherto seen the larvæ. After several failures in the attempt to rear the adult of this insect, the writer was finally suc-

[1] Published by permission of the Chief of the Bureau of Entomology.
[2] Cat. Brit. Mus. XXVIII, p. 290 (1863).

cessful in June, 1910. The material was submitted to Mr. August Busck who identified it as *Platynota rostrana* Walk.

The Cork-Colored Orange Tortricid is recorded as feeding on orange from St. George, Lake Bearsford, Enterprise, Ft. Ogden, Melbourne and Key Largo, Fla. In Columbia, Texas, it was found feeding on the flower buds and leaves of cotton by Dr. E. A. Schwarz and Mr. C. H. T. Townsend records it from Brownsville. The former has also collected the larva of this pest rolled in leaves of cotton at Bayou Sara, La., and it has been received from the same plant from Auburn, Ala. In 1885, Mr. J. W. Spencer of Sullivan County, Indiana, submitted corn infested with several pests, one of which proved to be *Platynota rostrana* Walk. The adult was reared by Mr. Theo. Pergande. This insect has also been collected at Kingston, Jamaica, by Mr. C. H. T. Townsend, feeding on the leaves of *Eucalyptus*. Aside from the localities previously mentioned, this comprises all the records in possession of the Bureau of Entomology.

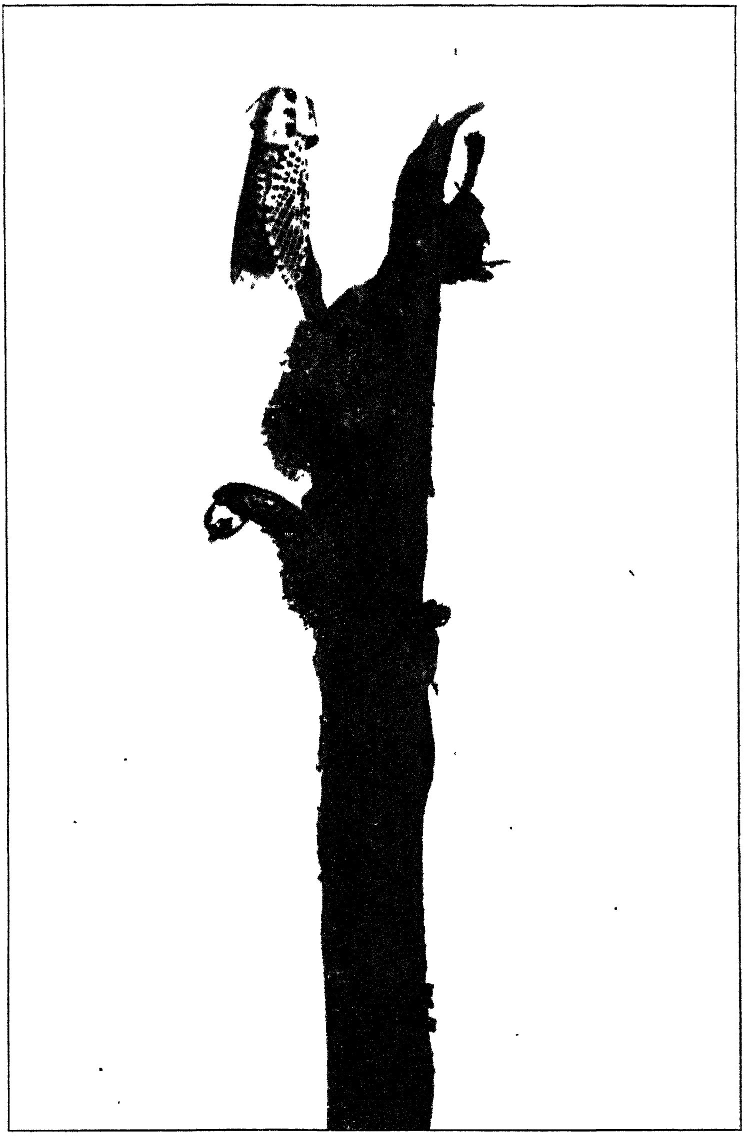
The damage to fruit by this insect is quite similar to that caused by the orange tortrix, *Tortrix citrana* Fernald, which at times becomes of economic importance in certain sections of the citrus belt in Southern California. In a recent paper[1] Mr. H. J. Quayle describes the manner in which the larvæ of the latter burrow into the rind of the orange and, as is also the case with the cork-colored orange tortricid, they do not enter the fleshy part of the fruit. Fruit exhibiting the burrows of these insects is necessarily classed as culls and when discovered in the packing houses is thrown out as such. Furthermore, as stated by Mr. Quayle, these burrows form excellent places for the development of naval end rot, wither tip fungus and decay following blue mold.

THE LEOPARD MOTH AS A PEST OF APPLE NURSERY STOCK

By W. E. Britton, *State Entomologist, New Haven, Conn.*

In September, 1910, during the course of the work of inspecting the nurseries of Connecticut, in one large fruit tree nursery not far from the coast, some apples trees were noticed which had borers working in the stems or trunks, which at that time were perhaps about three fourths of an inch in diameter. The foreman stated that they had found and destroyed a number of similarly infested trees. Three or four of these trees were cut, the stems split, and a whitish grub

[1] Jour. Econ. Entom., Vol. III, no. 5, p. 401, Oct., 1910.



Leopard Moth

with black spots was found tunneling inside. The sections of the trees containing the borers were taken home to the laboratory, the split portions tied together, and the sticks planted end up in a flower pot of moist sand and covered with a lantern globe cage. The larva continued to feed until reaching maturity, and in due time pupated in the burrow. The insectary being heated, transformations took place much earlier than would be the case normally out of doors, and the adult emerged on February 25, 1911. It proved to be the leopard moth, *Zeuzera pyrina* Linn., and the accompanying illustration, Plate 8, shows the male on the end of the apple tree stem stretching and hardening his wings.

Though the leopard moth has long been known to attack all kinds of deciduous trees, it had not in my experience appeared as a pest of nursery stock. It is causing much damage to shade trees in the cities and towns near the coast, but attacks the smaller branches and twigs especially, often killing them in the tops of large trees. To the best of my knowledge this moth is not found far inland, but since its introduction into this country some thirty or more years ago, it has spread from the vicinity of Hoboken, New Jersey, where it was first noticed, according to Smith's list, north as far as Paterson and south to Eatontown. It has gone eastward and northward along the coast as far as the vicinity of Boston, where it has caused serious damage to shade trees. In Cambridge, Providence and New Haven much injury by it has been reported.

Most writers claim that two years are required for the leopard moth to complete its life cycle, but, though I have not followed the insect through its different stages, I have some evidence indicating one year as the period necessary to produce a generation. We hope to be able to make further observations to settle this point.

There is not much danger of disseminating the species in nursery stock, as the work of the larva is apparent at digging time, and the infested trees are ruined and unsalable.

SOME NOTES ON PARANDRA BRUNNEA FABR.

By A. B. Gahan

United States Bureau of Entomology, Bulletin 94, part 1, treating of damage to chestnut telephone poles by the Cerambycid borer, *Parandra brunnea* Fabr., records the fact that the first instance of serious injury of this nature to come to the notice of entomologists, was that of a case in Maryland which was investigated by the present writer.

The following brief notes are here given regarding the results of that investigation, as adding somewhat to the history of the first discovery of the insect in this relation, rather than as adding anything of much importance to the knowledge of the insect or its work, as contained in the bulletin mentioned.

The Entomological Department of the Maryland Experiment Station obtained its first knowledge of the insect through a letter dated November 30, 1906, from Mr. Clarence Kirwan, Right-of-way Agent of the Cheasapeake and Potomac Telephone Company in Baltimore, Md., who stated that it was doing serious damage to the company's poles at Annapolis. He sent also specimens of the larvæ and their work.

Not being able to identify the pest, and hoping to secure further information, the writer went to Annapolis, December 6, and, with with the help of the company's agent at that place, dug up the stub of one of the poles which had broken off at the surface of the ground, and beside which a new pole had been set. The stub was of chestnut, and the company's men were of the opinion that it had been treated with some kind of preservative before being placed in the ground, but this was not proven.

That the breaking of the pole had been induced by the work of these insects was evident, since in digging it up, no less than a dozen of the larvæ were uncovered in the partly rotten exterior wood, and examination showed the solid heartwood to be honeycombed with burrows which were tightly packed with castings. The greater number of the larvæ were located within a few inches of the surface of the ground, but several were found to have gone down to a depth of two feet below the surface. Most of the larvæ were in the outer layers of the wood but many had penetrated to a depth of three or four inches. Several other poles were examined and found to be infested, but none so badly as this one. The company's men reported that they had found the same insect in a number of other localities south of Annapolis, where it was causing considerable damage. One instance of unset poles, which had been lying on the ground at the roadside for a period of eighteen months being badly infested, was reported.

The stub of the broken pole was shipped to College Park, and placed in a breeding cage, the bottom of which had been covered with moist sand. Specimens of the larvæ and their work were submitted to Dr. A. D. Hopkins, who stated that he was unable to identify it at that time, further than that it was the larvæ of a Cerambycid.

Frequent examinations of the infested poles were made during the spring, summer and fall of 1907, but without finding adult beetles. In November of that year, the pole was cut into and larvæ were found

still feeding and without signs of pupation. During the winter and spring of 1908, the writer was engaged on other work, and compelled to neglect the notes on this borer. However, on July 9, the cage was again examined, and a single female beetle found beneath the pole. July 27 a male was taken from the cage, and another of the same sex, two days later. On August 17, another female was secured. No more adults appearing, the pole was later taken out, and split up, no larvæ or pupæ being found.

While incomplete, these records show that the life cycle of this beetle extends over a period of at least two years, and more likely three years are occupied in its various transformations.

LOCOMOTION OF CERTAIN YOUNG SCALE INSECTS

By H. J. Quayle

The object of this paper is to present a few experiments on the powers of locomotion of the Black Scale (*Saissetia oleæ* Bern.), the Red or Orange Scale (*Chrysomphalus aurantii* Mask.) and the Purple Scale (*Lepidosaphes beckii* Newm.). These three scales represent the most important insect enemies of citrus trees in southern California, and the question of how they are spread and what part their own powers of locomotion play in the matter frequently come up for discussion.

The distribution of scale insects over long distances is effected mainly through the interchange of nursery stock, and over the same general community by birds and active insects, chiefly, together with the agency of man in his usual cultural operations, while in the spread from tree to tree or to nearby trees, aside from the above factors, the power of the insects to transport themselves must be taken into consideration. The wind is another factor which may aid certain insects in distributing themselves, either by blowing them directly or with a leaf or light twig upon which they may be resting. Such insects as winged plant lice or the males of scale insects have frequently been observed to be wafted by a gentle breeze or aided in their flight through its influence. Experiments with a foot bellows showed that young black scales are not very readily dislodged from a twig, but once dislodged might be carried a short distance as they fell. Twigs having numerous active young scales had to be brought to within about six inches of the mouth of the bellows before any of the insects were dislodged. It thus requires a stronger wind than

usually blows to have any effect on the scales on the tree, but once dislodged the wind might carry them to an adjoining tree if the foliage of the different trees were in close proximity.

Rate of Travel Over Smooth Paper

In order to determine the maximum distance that young scale insects would travel under the most favorable conditions, accurate records were made of the movement of the insects over smooth paper for two-hour periods. Tracings representing their actual movements were made on large sheets of paper and will be reproduced in a later publication. Tabulation of the data is given in the accompanying table. It will be seen that temperature has a very great influence on the activity of the insects. The minimum temperature of 73.5° F. on which records were made for the black scale shows a maximum distance traveled of 81 inches with an average of 71.5 inches, while with a temperature of 90° F. the maximum distance traveled was 180 inches with an average of 151 1-3 inches. It thus appears that an active young black scale will travel more than twice as far upon a raise in temperature from 70° to 90° F.

The influence of temperature is similarly shown in the case of the red scale. At a temperature of 66° the maximum distance traveled was 41 inches, while with a temperature of 91° the maximum distance

RATE OF TRAVEL OVER SMOOTH PAPER

Black Scale (*Saissetia oleæ* Bern.)

Exp. No.	Date	Time	Temp.	Distance	Av. Distance
1	Nov. 2, 1910........	1.45-3.45 p. m.	73.5 F.	70 in.	
1	Nov. 2, 1910........	1.45-3.45 p. m.	73 5	62 "	
1	Nov. 2, 1910........	1.45-3.45 p. m.	73 5	81 "	71.5 in.
2	July 5, 1910	2.15-4.15 p. m.	80	73 "	
2	July 5, 1910...... ..	2.15-4.15 p. m.	80	80 "	76 5 in.
3	Aug. 17, 1910.......	9.30-11 30 a. m.	83	103 "	
3	Aug. 17, 1910.......	9.30-11.30 a m.	83	140 "	
3	Aug. 17, 1910.......	9.30-11.30 a. m.	83	127 "	123.33 in.
4	July 19, 1910........	2.15-4.15 p. m.	90	108 "	
4	July 19, 1910........	2.15-4.15 p. m.	90	166 "	
4	July 19, 1910........	2.15-4.15 p. m.	90	180 "	151.33 in.

Red Scale (*Chrysomphalus aurantii* Mask.)

5	Dec. 6, 1909	2.20–4.20 p. m.	66	41 "	
5	Dec. 6, 1909........	2.20–4.20 p. m.	66	25.5 "	
5	Dec. 6, 1909.........	2.20–4.20 p. m.	66	34 "	
5	Dec. 6, 1909.........	2.20–4.20 p. m.	66	23 "	31 12 in.
6	July 20, 1910...... .	2.35–4.35 p. m.	91	111 "	111 in.

Purple Scale (*Lepidosaphes beckii* Newm.)

7	Nov. 18, 1910.......	9.20–12.20 a. m.	62	9 "	
7	Nov. 18, 1910.......	9.20–12.20 a. m.	62	21 "	
7	Nov. 18, 1910.......	9.20–12.20 a. m.	62	27 5 "	19.16 in.
8	Nov. 3, 1910..	2.10–4.10 p. m.	68	37.75 "	
8	Nov. 3, 1910..	2.10–4.10 p. m.	68	28 "	32.87 in.
9	July 21, 1910........	1.20–3.20 p. m.	89	111 "	111 in.

traveled in the two-hour period was 111 inches. In most cases these experiments started off with four insects but some would be lost or destroyed, so that completed records are given for but one in some instances. But since it was more desirable to have the maximum rate of travel in each case, one record, in the case of the higher temperatures, answers the purpose. With the purple scale the maximum distance traveled was 37.95 inches when the temperature was 68° and a total of 111 or more than three times the distance when the temperature was 89°.

Taking the maximum life of the active larva of each of these scales at 4 days, which seems from our experiments to be about correct, the possible maximum distance traveled during the period may be calculated. For the black scale the maximum rate of crawling for a two-hour period is 15 feet. If it continued at this rate without stopping for 4 days it would travel a total of 720 feet, but this is never actually done under natural conditions. In the first place it would never have as smooth a surface as paper to crawl over, and again it is not at all likely that such a rate of speed would be maintained constantly. On the same basis of calculation the red and purple scales would each travel a maximum distance during their active period of 444 feet. These scales almost invariably settle within one or two days after emerging, but in the absence of food they might continue to be active for 4 days. The purple and red scales travel at about the same rate for both the minimum and maximum tempera-

tures, as may be seen from the table. It was thought that the purple scale young being much larger than the red would travel faster. The young purple scale has very short legs in relation to the size of the body, these scarcely showing beyond the margins and this probably accounts for its slow and rather awkward movements. The black scale, on the other hand, is a much better traveler but, contrary to what was expected, the partly grown scale when it loosened its hold after becoming fixed, could not cover the distance traveled by those just emerged from beneath the parent.

In these experiments little difficulty was met with in keeping the insects within the limits of a sheet of paper. They would almost invariably travel toward the light, so that when one margin of the sheet was reached it was turned around so that the opposite margin was nearest the light and the scales would soon turn about and go in the opposite direction. From these observations and experiments where the light was regulated it is concluded that these young scale insects are positively phototropic.

Travel Over Sand and Orchard Soil

In the experiments on the rate of travel over sand and ordinary orchard soil, the material was placed in saucers, plates and large sheets of black paper. A narrow strip of tree tangle-foot was placed around the plate or paper a little beyond the soil to capture the insects as they crossed over. Galvanized iron cylinders were also sunk in the soil in the field and a strip of tanglefoot placed on this a few inches above the surface. These cylinders were about 10 inches high and varied in diameter from 1 to 4 feet. These were later discarded for large sheets on which the soil was placed, or circles of paper with the inside margins covered, thus leaving a strip around the outer margins of the soil area where the scales could be more closely examined upon making their way from the center. In the following experiments the details were largely carried out by E. W. Rust.

Black Scale.—Temperature 85° F. About 50 active young just taken from under the adult were liberated in a plot of sand 6 inches in diameter. After one-half hour 5 had reached the outer margin and in three-fourths of an hour about half of the insects had reached the paper. Distance 3 inches.

Temperature 84°. Several hundred active young were placed in the center of sand in a dish at 3.30 p. m. At 3.55 one reached the edge of the dish; at 4 another; at 4.02 two more; while five more reached the edge by 4.20 and ten more by 4.30. By 5 dozens had reached

the edge of the plate. Distance traveled 4 inches. A similar experiment with ordinary orchard soil gave similar results.

Temperature 84°. A plot of orchard soil one foot square was enclosed with paper and several hundred active young liberated. When the experiment was begun the morning was foggy. In 55 minutes three reached the paper, a distance of 6 inches. By this time the sun was shining and the temperature had arisen to 96°. At a temperature of 102° all the scales died.

Temperature 85°. Four hundred or five hundred young were liberated in the center of an area of soil 2 feet square at 10.15 a. m. By 12.30 p. m. about 20 reached the margin; by 1 p. m. nearly 50, and at 5 p. m. about 100. Distance traveled 1 foot. Similar experiments showed that with a 2-foot strip of soil to cross, the first insects reached the margin in approximately 2 hours. Where the width of soil was 4 feet, out of several hundred liberated only a very few succeeded in crossing it during the same day.

Experiments relating to the effect of high temperatures on young black scales showed that it is an important factor in the causes of death. Several hundred young black scales were liberated on white cardboard in the sun with a temperature of 94° to 100°; at the end of two hours they were unharmed by the heat. A similar experiment is recorded with a temperature of 106° to 110°. At 106 the scales were lively, but as the temperatures increased they moved more slowly, and at 110 almost all movement ceased, although a 2 hours' exposure did not kill them.

Several hundred just emerged black scales liberated on soil with a temperature of 108° to 110° were active for about 1 hour, but at the end of that period some were dead and at the end of 1½ hours nearly all had been killed. A check lot in the shade were not affected. A large number of young placed upon a board with a temperature of 118°, all died in 5 minutes. Scales exposed in sun on soil where temperature was 119° to 122° died within 15 minutes. Under similar conditions with temperature of 130° death resulted in 5 minutes. A check lot in the shade were not affected.

Red Scale.—Fifteen active young picked from orange were liberated in sand with a radius of 1 inch. Two had radii of 2½ inches, and 2 more measured 3 inches in radius. None crossed the soil, even in the narrowest strip of sand. One particular insect was watched closely for ½ hour and in that time traveled but a small fraction of an inch. Another experiment showed that 1 scale out of 20 liberated crossed a 2½-inch strip in 18 hours. This was repeated the following day when none crossed over the soil. Twenty were liberated in the center of a 2-inch radius of soil and none reached the edge in 3 hours.

This was repeated twice and even on the following day none succeeded in crossing the soil.

Purple Scale.—At 9 a. m., September 17, with a temperature of 86°, 25 young purple scales were placed unharmed in the center of an area of sand having a 5-inch radius. None of these reached the edge during the same day nor the day following. A similar experiment resulted negatively. A third similar to the others was started at 9.45 and out of 25 liberated one reached the margin at 3.30 (5 3-4 hours). This is the only one that succeeded in crossing a 5-inch strip of sand. The following records were made on a 3-inch radius of sand:

9–20–10 T. 93° 20 liberated at 1.30 p. m. No results.
9–21–10 T. 82° 20 liberated at 9.45 a. m., 2 out at 12.30 p. m.
9–22–10 T. 65° 10 liberated at 9.30 a. m., 2 out at 1 p. m.
No more emerged by 5 p. m. or during next forenoon.

The experiments recorded here represent but a few of the total number made, but they will serve to show how they average. In the case of the black scale it was shown that about 4 feet of ordinary orchard soil is about the limit that will be traversed by the active young. Under favorable conditions they might, therefore, through their own powers of locomotion make their way from one citrus tree to another or to a second or third tree away. But the number thus traveling would be exceedingly small as compared with the total. These records were made on soil with an ordinary mulch. Tests were made on their powers of traveling over compact soil and they invariably showed very much greater progress. A compacted irrigation furrow enabled even the young red scale to travel two or three feet, while in a loose mulch this scale makes practically no progress. The young red scale in attempting to ascend a small particle of earth falls back again and this is repeated time after time. The same is almost as true for the young purple scale. Where there is a fine mulch, therefore, the chances of the young red or purple scale reaching an adjoining tree is practically negligible.

THE LIFE-HISTORY OF THE WALKING-STICK, DIAPHEROMERA FEMORATA SAY

By Henry H. P. Severin, Ph. D., *Professor of Zoölogy and Entomology, College of Hawaii*, and Harry C. Severin, M. A., *Professor of Entomology, South Dakota State College of Agriculture and Mechanic Arts*

(With Figs. 7–9, in Text.)

A number of naturalists have worked on the life-history of *Diapheromera femorata*, without as yet having accurately determined the number of molts that this insect undergoes. Riley (63, 73, 74 and 76) claims in several papers that this species "molts but twice," and this mistake has been carried into a number of text-books on entomology as well as into some bulletins and reports of the State Experiment Stations. Thomson (97) had some eggs of *Diapheromera femorata* sent to him from Toronto, Canada, and reared the walking-sticks which hatched from these in the Zoölogical Society's Garden at London. He claims that his specimens molted but four times. During the last four years we reared one hundred *Diapheromera femorata* under conditions which we made as normal as possible and found that twenty-three per cent. molted four times, seventy-six per cent. five times, and only one per cent. six times.

Bordage (8), in working with the walking-sticks, *Monandroptera inuncans* and *Raphiderus scabrosus*, found that there were five or six molts in both of these species. De Sinéty (90) found that the Asiatic species, *Menexenus obtusespinosus*, molted either four or five times and *Dixippus morosus* five or six times. Meissner (55), however, in a recent paper on *Dixippus morosus* claims that "sämtliche 42 von mir bis zum Imaginalstadium gezogenen Tiere haben sechs Häutungen durchgemacht; ich halte es auch für unwahrscheinlich, dass weniger vorkommen sollten." Evidently, this author was not acquainted with de Sinéty's (90) work on this same species. La Baume (4), in a recent paper on *Dixippus morosus*, writes as follows concerning the number of molts of this insect: "Die Anzahl der Häutungen gibt de Sinéty auf 4 bis 6 an . . ." Evidently La Baume has erred, for de Sinéty writes, "Dans les espèces asiatiques, nous en avons constaté tantôt un nombre fixe, . . . peut-être faute d'un nombre suffisant d'experiences 7 chez *Clitumnus patellifer* tantôt un nombre variable; 5 et 4 (*Menexenus obtusespinosus*), 6 et 5 (*Dixippus morosus*)."

The question naturally arises, what is the probable explanation of this discrepancy concerning the number of molts of *Diapheromera femorata?* Diapheromera, after casting its exoskeleton, eats a large

part of or even the entire exuvium, and it may be possible that Riley overlooked some of the molts on this account. If Thomson did not fall into this same error, it is difficult to explain why all of his walking-sticks should have molted four times. He writes, "the first specimen emerged on the 11th of June, and others from time to time during the summer. They changed their 'skins' four times before reaching maturity." In Wisconsin, the walking-sticks hatch in June also, but we noticed, as Riley (63, 73 and 74) also describes, that "some of them, however, continue hatching much later, so that all through the summer and even into fall, young individuals may be found."[1] In their natural habitat in Wisconsin, the walking-sticks feed most abundantly upon the leaves of the hazel-nut shrubs (*Corylus americana* Walt.) and to some extent upon the leaves of the linden (*Tilia americana* L.).

The following table shows the number of male and female walking-sticks which molted four, five or six times. All of these specimens were reared from fertilized eggs under normal conditions.

TABLE I

NUMBER OF MALE AND FEMALE DIAPHEROMERA FEMORATA WHICH MOLTED FOUR, FIVE OR SIX TIMES.

	♂	♀
Number of walking-sticks which molted four times	18	5
Number of walking-sticks which molted five times	34	42
Number of walking-sticks which molted six times		1
	52	48

It is evident from this table, that in those specimens which molted four times, the males greatly outnumbered the females.

The interval or periods between the molts (stages or stadia) and the total duration of these periods (or the post-embryonic development) in Diapheromera reared under normal conditions during June July and August, which time corresponds to the normal period of development of this Phasmid in its natural habitat in Wisconsin, is shown in the following table. In this table the specimens are arranged

[1] The development of *Diapheromera femorata*, however, is often retarded by parasitism, which fact may account for some of the immature walking-sticks being found late in autumn in Wisconsin. We have reared a leaf-ovipositing Tachinid, which Townsend (98) has recently described as *Phasmophaga antennalis* for us. This year (1910), a large number of walking-sticks parasitized by a host-ovipositing Tachinid were found. We succeeded in obtaining the egg, larval and pupal stages of this parasite but at the present writing the imago has not yet been bred.

in groups, the grouping being made according to sex and the number of molts.

TABLE II

STAGES IN MOLTING IN DAYS OF DIAPHEROMERA FEMORATA REARED IN JUNE, JULY AND AUGUST.

Date of hatching	Sex	Number of molts	Stadium I	Stadium II	Stadium III	Stadium IV	Stadium V	Stadium VI	Post-embryonic development	Date of last molt
1909 6/9	♂	4	14	7	10	9	.....	..	40	7/19
1909 6/9	"	"	15	7	10	10	...	....	42	7/21
1909 6/11	"	"	13	7	9	9	.....	....	38	7/19
1909 6/12	"	"	11	8	10	11	.....	....	40	7/22
1909 7/22	"	"	10	9	11	13	.....	.....	43	9/3
Averages			12.6	7 6	10	10 4			40.6	
1909 6/9	♀	4	15	7	9	7	.....	...	38	7/17
1909 6/9	"	"	15	9	11	9	.....	.....	44	7/23
1909 6/12	"	"	13	9	10	8	.....	..	40	7/22
1909 6/12	"	"	13	13	8	10	.....	.....	44	7/26
1909 6/13	"	"	13	9	10	9	.....	.....	41	7/24
Averages			13.8	9.4	9.6	8.6			41.4	
1907 6/13	♂	5	8	7	9	9	10	.....	43	7/26
1907 6/22	"	"	10	9	9	9	8	.....	45	8/6
1908 7/6	"	"	9	9	7	9	11	.....	45	8/20
1908 7/9	"	"	12	8	9	11	13	.....	53	8/31
1908 7/13	"	"	10	7	7	11	13	....	48	8/30
Averages			9.8	8	8 2	9.8	11		46.8	
1908 6/23	♀	5	13	8	9	7	9	....	46	8/8
1908 6/24	"	"	13	10	9	8	13	.....	53	8/16
1908 6/30	"	"	12	9	9	9	12	.....	51	8/20
1908 7/17	"	"	10	6	8	10	13	.....	47	8/31
1908 7/22	"	"	10	9	9	12	10	......	50	9/10
Averages			11 6	8 4	8.8	9.2	11 4		49.4	
907 6/13	♀	6	8	7	9	8	9	12	53	8/5

From this table, it is evident that there is a wide variability in the interval between the different molts in the same walking-stick and also a considerable amount of variation in the time of corresponding periods in different specimens. The period between molts varies, under normal conditions, from six to fifteen days, the first and last stadia being usually somewhat more prolonged than the intermediary ones. And yet Trouvelot (99) writes, that in the case of *Diapheromera femorata* "he had observed many specimens and the interval of molting was always seventeen days." What wonderfully regulated specimens he must have observed!

The following table shows the average measurements of various parts of the body of ten walking-sticks after the first and second molts and of five or ten male and female specimens after the third, fourth and fifth molts:

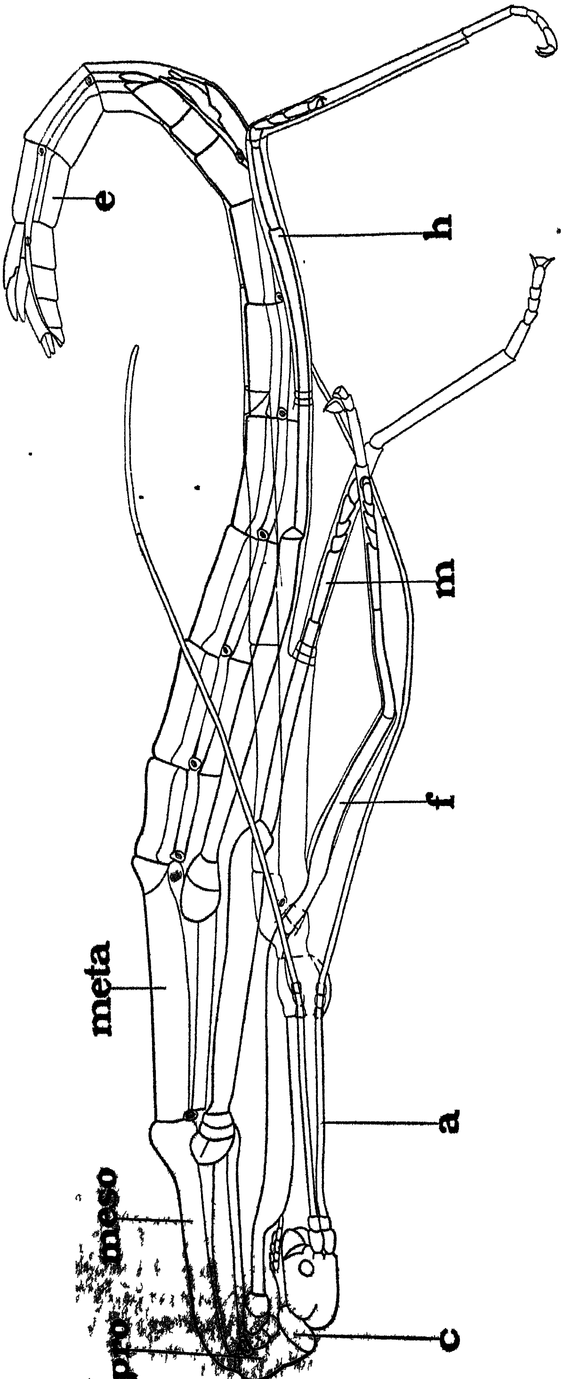


Fig. 7. Female *Diapheromera femorata* in the process of molting: *pro*, prothorax; *meso*, mesothorax; *meta*, metathorax; *c*, cervical ampulla which is a soft membrane joining the head dorsally to the prothorax; *e*, exuvium; *f*, front leg; *m*, middle leg; *h*, hind leg; *a*, antenna.

TABLE III

AVERAGE MEASUREMENTS IN MM. OF DIAPHEROMERA FEMORATA AFTER EACH MOLT.

	I Instar	II Instar	III Instar ♂	III Instar ♀	IV Instar ♂	IV Instar ♀	V Instar ♂	V Instar ♀	VI Instar ♂ mature	VI Instar ♀ mature
Length, distal end of front legs to end of abdomen.....	18 5	31.	46.5	46.	66.5	68 5	96 5	91.5	126.5	121 5
Length, head and body............ .. .	10 7	19.8	30.5	30.7	43.5	45.	56 5	61 5	75.	80.
Length, head.........................	1.1	1.3	2.	2.	2.5	2.5	2.5	3.	3.	4.
Length, pronotum.....................	.6	1.	1.5	1 5	2.	2.	2.	2.5	3.	3.
Length, mesonotum....................	2.5	4.	6.2	6 2	9.	9.5	12.	12.5	16.	16 5
Length, metanotum (with median segments)..............................	2.	3.5	5.5	5 5	8.	8.	11.	11.	15.	14
Length, abdomen......................	4.5	10.	15 3	15.5	22.	23.	29.	32.5	38	42 5
Length, front femora.............	3.	5.	7.	7.	10.	10.	15 5	13.	21 5	17.
Length, middle femora.................	2.	3.5	5.	4.8	7.	7.	10.	9.	14.5	12.
Length, hind femora..................	2.5	4.	6.	5.8	9.	9.	14.	11.	17.	15.
Length, antennæ......................	8.5	11.5	16.5	16 3	24.	24.	46.5	37.	56.	46.

A comparison of the average measurements of the male and female walking-sticks, which completed five molts, shows that the males excel the females in the lengths of the antennæ, all of the femora and in the distance from the distal end of the extended front legs to the end of the abdomen; the females, however, excel the males in the length of the abdomen.

There are certain indications which appear when the walking-stick is about to molt. The body becomes greatly distended, the lateral folds of the abdomen as well as the membranous connections between any two adjacent segments becoming greatly stretched; the body, in short, shows a rounding out, a certain fullness and plumpness. Previous to ecdysis, the Phasmid also stops eating and empties out most of the material from the digestive canal; but if, after molting, the chitinous lining of the fore-intestine and hind-intestine of the exuvium is examined, it is evident that not all of the contents have been evacuated. When hatched from the egg, the young creature is of a uniform pale green color, which a day or two before the first or second ecdysis deepens into a darker green; after either of these molts, the young walking-stick again assumes the uniform pale green color.

La Baume (4), in discussing the coloration in Diapheromera claims

that, "Die Jungen sind nämlich vom erwachsenen Tier gänzlich verschieden: sie sind vollkommen grün gefärbt. . . . Erst kurz vor der letzen Häutung geht diese Färbung allmählich in Braun über." Although we are dealing with the same species, our observations not only upon specimens reared in captivity, but also upon hundreds of individuals collected in their natural habitat are very different from those of this investigator. Many walking-sticks change their color from green to various shades of brown during the interval between the second and third molts, but more often after the third ecdysis Many female walking-sticks retain the green color throughout their natural life; in others, however, a marked individual variation in the color patterns exists after the last ecdysis, such as various shades of grey, brown or brick red often combined with various mottlings. Males which pass through four, five or six molts to complete their post-embryonic development, always have the characteristic adult color pattern after the last ecdysis; a day or two before the last molt, the newly developing color pattern becomes very prominent, especially in those specimens which have retained the green color up to this time.

In molting, the Phasmid bends down the prothorax at its union with the mesothorax so that the head lies beneath the latter (Fig. 7, *pro*). The top of the head may be in contact with a leaf, stem or other object, while the front legs and antennæ are thrown back along the sides of the body.

In the Phasmidæ, Mantidæ, Blattidæ and Acridiidæ, the cervical ampulla plays an important rôle in the process of molting. It consists of a soft membrane joining the head dorsally to the prothorax (Fig. 7, *c*) and can be transformed by the afflux of blood into a greatly swollen pouch, which projects out immediately behind the head. The turgidity necessary to break the old chitinous integument in the Acridiidæ is produced as follows according to Kunckel d' Herculais (50): "*ils remplissent leur jabot d'air au point de le distendre complètement;* des contractions musculaires, même peu énergiques, peuvent alors aisément chasser le sang dan l'ampoule cervicale. On comprend, d'après cela, que l'effort exercé par l'ampoule est d'autant plus energique que le jabot est plus gorgé d'air."

The old chitinous exoskeleton splits longitudinally at the region of the cervical ampulla and this split increases in length during the process of extrication. After the insect has completely withdrawn itself from the exuvium, the cleft extends along the dorsal median line from the head region to the posterior end of the thorax.

During the process of ecdysis, the dorsal surface of the prothorax pushes out first from the old integument; next comes the head, fol-

lowed then by the rest of the thorax, and finally by the abdomen (Fig. 7). Of the appendages, the middle legs are liberated first, then the antennæ, followed by the front and finally by the hind legs. One can easily observe the body and legs gradually withdrawing as the old skin becomes empty (Fig. 7, *e*).

A molting specimen examined under a binocular microscope, shows that a peristaltic-like movement passes from the posterior end of the abdomen forward at intervals. With each series of these movements the body is withdrawn a short distance out of the old skin, the legs assisting in this process of extraction from the old integument. At each attempt to withdraw the legs from the old exoskeleton, such an energetic pull is exerted upon the limbs, that each coxa presses against the body and forms there a temporary indentation.

After the walking-stick has withdrawn its appendages, it appears to be exhausted by the tedious task of ecdysis. It frequently happens that the entire body is not completely withdrawn from the cast skin, and in such instances the insect may remain suspended by the tip of the abdomen within the exuviated integument for half an hour or longer. In this position the head hangs downward, the legs are sprawled out and the antennæ are held forward parallel to the long axis of the body. This attitude does not have any resemblance to the characteristic resting posture which the walking-stick assumes during the day-time; but in all probability it allows the newly exposed integument to harden and prevents any malformations from developing.

The body of the walking-stick, as well as the legs and antennæ, may assume all sorts of abnormal shapes when the insect is unable to extricate itself entirely from the exoskeleton. If, in the process of molting, a specimen falls from the leaf or branch to which it was clinging to the bottom of the breeding cage, many malformations may result, especially if the insect experiences difficulty in withdrawing from the old skin. If any leg should happen to be caught in the exuvium, that leg is usually thrown off. We have observed one male individual throw off all of its legs during the last molt and even then it was unable to free itself entirely (Fig. 8). After the newly exposed integument of this specimen hardened, the body assumed an S shape (Fig. 8). It may be possible, that whenever difficulty of this nature occurs during the process of molting that the exuvial or molting fluid which lubricates the two skins at the time of ecdysis, hardens and prevents the parts from being extricated. In all probability autotomy among the Phasmidæ owes its origin to the difficulty experienced in withdrawing the appendages during the process of ecdysis.

An exuvium immediately after being shed, may be stretched out

without tearing, but after a short time the old integument hardens and it cannot then be extended to its full length.

Fig. 8. Male *Diapheromera femorata*, which threw off all of its legs during the last molt.

After molting, the walking-stick usually eats its cast-off skin. The following observations of a specimen eating its former exoskeleton are copied in detail from our notebook:

The insect was suspended by the posterior end of the abdomen in the molted skin for forty minutes. The tibiæ were then flexed at the knee producing a twitching movement. Suddenly the Phasmid bent its body upward, the legs caught hold of the petiole of the leaf, and the terminal end of the abdomen was pulled out of the exuvium. It began to feed on the head of the molted skin at once and bit off both antennæ and one of the front legs, the latter adhering to the leaf by the tarsus. The basal ends of both antennæ were consumed at the same time, the antennæ swaying around in all directions with each bite. Next, the front leg which adhered to the leaf was bitten in two through the femur, after which this free portion of the leg was devoured, femur first. The walking-stick now bit off the other front leg at the coxa and left it hanging on the leaf by the tarsus. Next it started to eat the mesothorax of the discarded integument. When the walking-stick came to the middle legs, it took the bent knee of one of these legs into its mouth and consumed the femur and tibia at the same time. The creature then bit off the other middle leg at the coxa and ate it. It now began to eat at the posterior end of the abdomen and met with one of the hind legs lying along the side of the abdomen. The tarsus of this leg was bent at the joint with the tibia and this bent portion entered the mouth first, the tarsus and part of the tibia being consumed at the same time. It ate the rest of the tibia and left the femur untouched. Next the Phasmid tasted the metathorax, but soon it came back to the femur and ate this portion of the leg. Then the insect bit off the other hind leg at the coxa, but the leg dropped to the ground. Finally the walking-

stick devoured the remaining portion of the metathorax and abdomen. The appetite of the creature was still not satisfied, for it went carefully over the leaf, vibrating the palps continually in search of more of its integument. Finally the walking-stick discovered the front leg, which was still adhering to the leaf and devoured it. Again it began to search actively for more of its former exoskeleton. We then took another molted skin of a different walking-stick and offered it to the greedy creature, and the Phasmid began to devour this skin also. It ate, however, only the head and front leg, when it was disturbed at its meal by another walking-stick coming in contact with it. Apparently the instinct of the walking-stick does *not* carry it far enough to recognize its own molted skin.

Godelmann (33) in his work with *Bacillus rossii* writes, "Nach der letzten Häutung, die bei meinen Zuchten etwa in December erfolgte, beginnt das Thier sofort Eier zu legen." Meissner (55), however, found that with *Dixippus morosus*, "Etwa 8–10 Tage nach der VI Häutung beginnen die Imagines Eier abzulegen und setzen dies nun ständig fort." With *Diapheromere femorata*, we also found that the females do not begin egg-laying immediately after the last molt, but that there is an interval of 6 to 10 days between the last molt and the laying of the first egg. These intervals in three specimens, which had been reared under as nearly normal conditions as possible and which had molted four times, were 7, 9, and 10 days, or on an average 8.66 days; the intervals in twelve walking-sticks which had molted five times, were 6, 6, 7, 8, 8, 8, 8, 8, 9, 10, 10 and 10 days, or on an average 8.16 days. From the averages it is apparent that no very great difference exists in the interval between the last molt and the laying of the first egg in the walking-sticks which molt four or five times.

Specimens of Diapheromera, which molted four times, reached sexual maturity, on an average, in 50.06 days, while individuals which molted five times required 57.56 days on an average, or an extra 6.6 days before beginning the egg-laying period. It is evident thus, that those walking-sticks which molted four times, omit the fifth molt and yet reach sexual maturity nearly a week earlier than those specimens that pass through five molts. In all probability, temperature plays an important rôle in the rate of development, but temperature alone does not explain why some walking-sticks molt four times and others five times. We have repeatedly reared a number of Diapheromera which were hatched on the same day, fed with the same kind of food and kept in the same breeding cage throughout their entire life history under exactly the same conditions of temperature, and yet some specimens molted four times while others molted five times. Further experiments are necessary to determine a solution of this problem.

The eggs, after passing out of the vaginal orifice, may be retained

for a number of hours within the peculiar "external uterus" formed by the ovipositor (Fig. 9, *e*).

After being released by the ovipositor, the eggs are dropped, one at a time, to the ground from wherever the female may be. In this way the eggs are scattered upon the ground below the natural food plant and here they remain over winter. Riley (63, 73 and 74) gives an interesting account of the egg-laying in *Diapheromera femorata*, an insect which may, at times, become exceedingly abundant and very injurious. He writes, "The eggs are simply dropped loosely

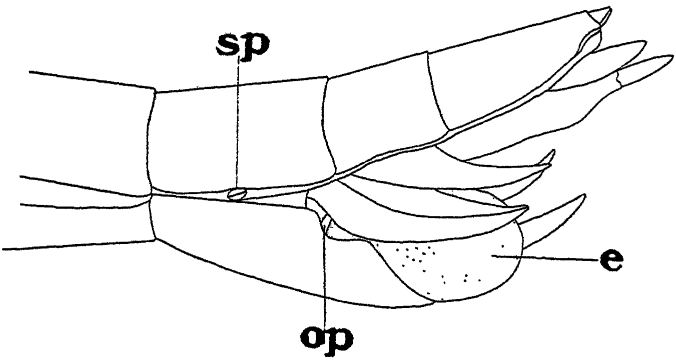


Fig. 9. The posterior end of the abdomen of a female *Diapheromera femorata*, showing an egg held within the "external uterus" formed by the ovipositor; *sp*, spiracle; *e*, egg; *op*, operculum.

upon the ground from whatever height the female may happen to be, and, during the latter part of the autumn where the insects are common, one hears a constant pattering, not unlike drops of rain, that results from the abundant dropping of these eggs which in places lay so thick among and under dead leaves that they may be scraped up in great quantities."

Concerning the egg-laying of *Bacillus gallicus*, Dominique (21 and 25) emphasizes the fact that "jamais nous n'avons en à enregistrer une seule ponte diurne." *Diapheromera femorata*, however, lays its eggs during both day and night.

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TWO RHOPALOSIPHUM SPECIES AND APHIS PULVERULENS, N. SP.

By C. P. Gillette.

Rhopalosiphum pastinacæ (L.) and *R. capreæ* (Fab.)

Apparently these two species have been confused by aphidologists. As I have material that seems to me to straighten out the tangle, I venture to give it.

The description of *pastinacæ* by Linnæus is satisfied about equally well by the louse I am considering as this species, and by the louse described by Fabricius, and later by Kaltenbach[1] as *capreæ*. At least, the species considered in this paper as *pastinacæ* answers the Linnean description and does not answer the excellent description of *capreæ* as given by Kaltenbach. More recent descriptions seem mostly to have been of *capreæ* and under several different names.

Rhopalosiphum capreæ Fab. Perhaps the fact that Koch[2] de-

[1] Monographie der Pflanzenlause, 1843, p. 109.
[2] Die Pflanzenlause Aphiden, 1857, p. 41.

scribed and figured this species as *pastinacæ* has had much to do to cause the confusion of later writers. Koch's *capreæ* seems to be neither this species nor *pastinacæ*. Buckton[3] recognized the prominent distinctive characters of the two species, as did Passerine. Mr. J. T. Monell[4] obtained his *salicis* from willow and described the winged form without noticing the small supra-caudal tubercle. In a recent letter Mr. Monell has told me that he now considers his *salicis* synonymous with *capreæ* Kalt. Doctor Weed[5] later found the sexuales of this species on willow in Ohio and described them as *Siphocorinæ salicis* Monell. Mr. J. J. Davis has called my attention to the fact that Doctor Oestlund[6] seems to have described this louse as *archangelicæ* which seems to me to be the case. I have not come upon any description of *pastinacæ* since Buckton's, already mentioned, except that of *xylostei* Schr., which is probably a synonym of this species. The striking character in *capreæ*, which in the material that I have studied is constant in all forms, larvæ, alate and apterous viviparæ, sexuales, and pupæ, is the supra-caudal tubercle or spine which, in the apterous form, is as long or longer than the cauda, but which is a tubercle only in the alate forms (See figures.).

All the specimens of these two forms that I have seen, separate readily into two very distinct species without intergrading, and without a mingling of the two forms in the same lot as follows:

Joints 4, 5, 6, and antennal spur sub-equal, the spur usually distinctly the longest, cornicles fully ¾ as long as 3d joint of the antenna, a small tubercle on the alate form and a large one on the apterous individuals always present.......... *capreæ*.

Joint 6 of the antenna distinctly shorter than 5, the 4th still shorter and its spur nearly as long as joints 4, 5 and 6 combined, cornicles seldom much exceeding ½ the 3d joint of the antenna in length, and supra-caudal tubercle or spine entirely absent .... *pastinacæ*.

Kaltenbach called attention to the interesting habits of *capreæ* in that it lived upon two very different groups of plants, the willows (*Salix* species) and several species of the Umbelliferæ. Later writers have added to the number of food plants but, so far as I have learned, they have all been willows or members of the parsley family.

The food plants given for *capreæ* by the writers mentioned, and by Fabricius and Schrank are as follows:

Fabricius.—*Salix capreæ*.

Schrank.—Willow.

Kaltenbach.—*Salix amygdalina, babylonica, capreæ,* and *alba, Heracleum siphondylium, Angelica sylvestris, Aegopodium podograria, Choerophyllum temulum, Pastinacea sativa* and *Conium maculatum*.

[3]Monograph of British Aphids, II, pp. 25, 27.
[4]Bull. 5, U. S. Geol. Survey, 1879, p. 26.
[5]Trans. Amer. Ent. Soc., 20, 1893, p. 297.
[6]Aphididæ of Minn., 1887, p. 70.

Koch.—*Salix caprea.*
Buckton.—*Salix* species.
Monell.—*Salix lucida, nigra* and *babylonica.*
Oestlund.—*Angelica atropurpurea.*
Weed.—*Salix* species.

From Mr. Bragg's collections made at Fort Collins, Col., I extract the following records: From parsley, *Petroselinum hortense,* August 25, 1907, October 5, 1907, November 1 to 25, 1910, and from willow, June 22, 1908. Mr. Bragg also took this species at Amherst, Mass., July 26, 1909, on *Pastinaca sativa,* and at Webster, Mass., July 26, on the same plant and on caraway, *Carum carui.*

Prof. Ellsworth Bethel of Denver, Col., sent me a fine lot of specimens which he took at Tolland, Col., at an altitude of 8,000 feet on *Ligusticum porteri,* October 19, 1908.

I have also received specimens from Prof. Edith M. Patch taken at Orono, Me., on caraway, July 29, 1910, and Mr. J. J. Davis wrote me from Chicago that he had taken the same louse in great numbers from *Zizia aurea* in Illinois.

So all the way through this species seems to hold to species of *Salix* for the winter host plant and to species of *Umbelliferæ* for its mid-summer hosts as Kaltenbach pointed out when he wrote his description.

Rhopalosiphum pastinacæ (L.). Linnæus described this species from the common parsnip, *Pastinaca sativa.* The only subsequent description I have seen of this species under this name is the one by Buckton in his Monograph, volume II, p. 25. It seems to me very probable that *xylostei* Schr. is a synonym of this species. Shrank's description would not indicate a different species; Kaltenbach's description of it fits *pastinacæ* which he seems not to have known, and the description by Buckton hardly indicates that *xylostei* is a good species. Schrank took this species from honeysuckle (*Lonicera* sp.); Buckton records his specimens from *Lonicera xylostei* and *periclyneum*; Kaltenbach's were from *Lonicera periclyneum* and *Conium maculatum,* and Koch records his from *Lonicera xylostei.* A slide from Mr. Monell labeled *xylostei* is marked "*Lonicera pastinaca* St. Louis, November 4" and I have just recently received specimens of what seems to be the same louse from Miss Mary Murtfeldt, Kirkwood, Mo., which she reported to be injuriously abundant upon honeysuckle nearly every year.

These references to *xylostei* records are given to show how perfectly the food plants fit in with those of what I have been calling *pastinacæ,* and which seems to have for its hosts several species of the *Umbelli-*

feræ during the summer months and the honeysuckles (*Lonicera* sp.) during fall, winter and spring.

Our specimens of *pastinacæ* have been taken by Mr. Bragg as follows: From *Heracleum lanatum* October 27 and 28, 1908, and November 1, 1908; in all cases alate viviparous females and a few winged males were taken but no oviparous females. From honeysuckles (*Lonicera* sp.) specimens were taken June 28, 1910, July 2, 1907, and September 28, 1910, all viviparous females; specimens taken October 9, 1910, October 11, 1910, November 7, November 10 and November 12, 1910, all had males and oviparous females.

The conclusions then are that these species of Rhopalosiphum have several species of the Umbelliferæ as summer host plants, that *capreæ* goes to the willows for the fall, winter and spring, that *pastinacæ* goes to the honeysuckles for the winter, that *xylostei* is probably a synonym of *pastinacæ* though I have no European material of this species to study, that Koch's *pastinaceæ*, Monell's *salicis*, and Oestlunds *archangelicæ* are all *capreæ*.

Descriptions of *Rhopalosiphum capreæ*. Plate 9, Figures 10–16.

Specimens from garden parsley, *Petroselinum hortense*, at Fort Collins, Colo., November 1, 1910.

Alate Viviparous Females.—Color of prothorax and entire abdomen green with slight pulverulence beneath. Head, antennæ, mesothorax above and below, metathorax, tarsi, and distal ends of tibiæ black; legs otherwise yellowish green as are the cornicles and cauda; anal plate dusky, cornicles and cauda in some examples a little dusky. The cornicles are .30 to .35 mm. in length, slender at base and enlarging at the middle to twice the basal diameter and somewhat constricted again near the tip, which ends in a moderate flange; length of cauda, .10 mm.; above the cauda is a prominent tubercle from ⅓ to ½ the length of the cauda (see Fig. 11). Length of body 1.50 to 2 mm.; length of antenna 1 to 1.10 mm.; length of wing 2.60 mm. Joints of antenna about as follows: III, .32–.37; IV, .13–.15; V, .12–.13; VI, .12–.13; spur, .15–.17 mm.; joint III tuberculate with numerous sensoria.

Apterous Viviparous Female.—General color pale greenish to very pale yellowish with no dark parts but the eyes and tarsi. The striking peculiarity of this form is the tubercle upon the 8th segment which is as long as the cauda and blunt at the apex (see Fig. 12). Length of body 1.70 to 2 mm.; cornicle .40 mm. long, the club being less abrupt than in the alate form. Antenna .80 mm. long; joints III, .20; IV, 10; V, .10; VI, .10; spur, .13 mm. There are distinct antennal tubercles and the body is remarkably smooth and free from hairs and on the dorsum the surface is minutely punctate.

The larvæ and pupæ also show the tubercle well developed.

Alate Male.—I have seen but one male. It was taken from parsley November 1, 1910, and differs from the alate viviparous female by being smaller, and by having a larger number of sensoria on joint 3, about 7 on joint 4, about 7 on joint 5, and 4 on the sides of joint 6.

Aphis pulverulens, n. sp. Plate 9, Figures 1 to 9.

Specimens taken from *Symphoricarpos occidentalis* at Fort Collins, May 31, 1909; L. C. Bragg, collector.

Apterous Viviparous Female.—The body is covered with a white silvery secretion, giving it the appearance of a species of *Pemphigus*. When the secretion is removed, the body is of a sordid greenish brown color. The greater portion of the antennæ, the tarsi, distal ends of tibiæ, distal portion of beak and eyes are black, or blackish. The eyes are really a very dark red; the head and prothorax are a little dusky, as are the basal joints of the antennæ; the head and prothorax are very narrow; the antennæ are on somewhat prominent tubercles, which, however, have no length on the lateral margins next to the compound eyes; joint 6 of antenna tapering gradually into spur; cornicles short and weak and somewhat curved and light in color, very smooth and with little or no flange, diameter slightly greater near the base than near the distal end; cauda broadly rounded, and not more than half as long as it is wide on the basal margin; beak barely attaining third coxæ; body very smooth and free from hairs.

Body varying little from 3 mm. long by 1.07 mm. wide. Length of cornicles .21 mm.; hind tibiæ 1.63 mm.; joints of antennæ: III, .90; IV, .49; V, .37; VI, .14; spur, .57 mm.

The larvæ are pale carneous and may be tinged with green.

It seems likely that these apterous females are stem-mothers.

Alate Viviparous Females. Reared from the same lot as the apterous form described above.

The entire body and legs are covered with a cottony secretion as in the apterous form. General color of body, legs and antenna the same as in the apterous. Lobes of the thorax above black, head and prothorax black or blackish, cornicles as in the apterous form except that they are dusky brown in color. Antennæ with numerous hairs, and tuberculate sensoria; cauda small, rounded at apex, broader than long; cornicles weak and without flange; stigma of wing long, narrow and parallel sided, second fork of cubitus a little nearer the apex of the wing than to the first fork.

Length of body 3 mm., width 1.34 mm.; antennæ 2.78 mm.; joints of antennæ about as follows: III, .90; IV, .57; V, .43; VI, .13; spur, .59 mm.; cornicle, .20 mm.; wing, 4 mm.

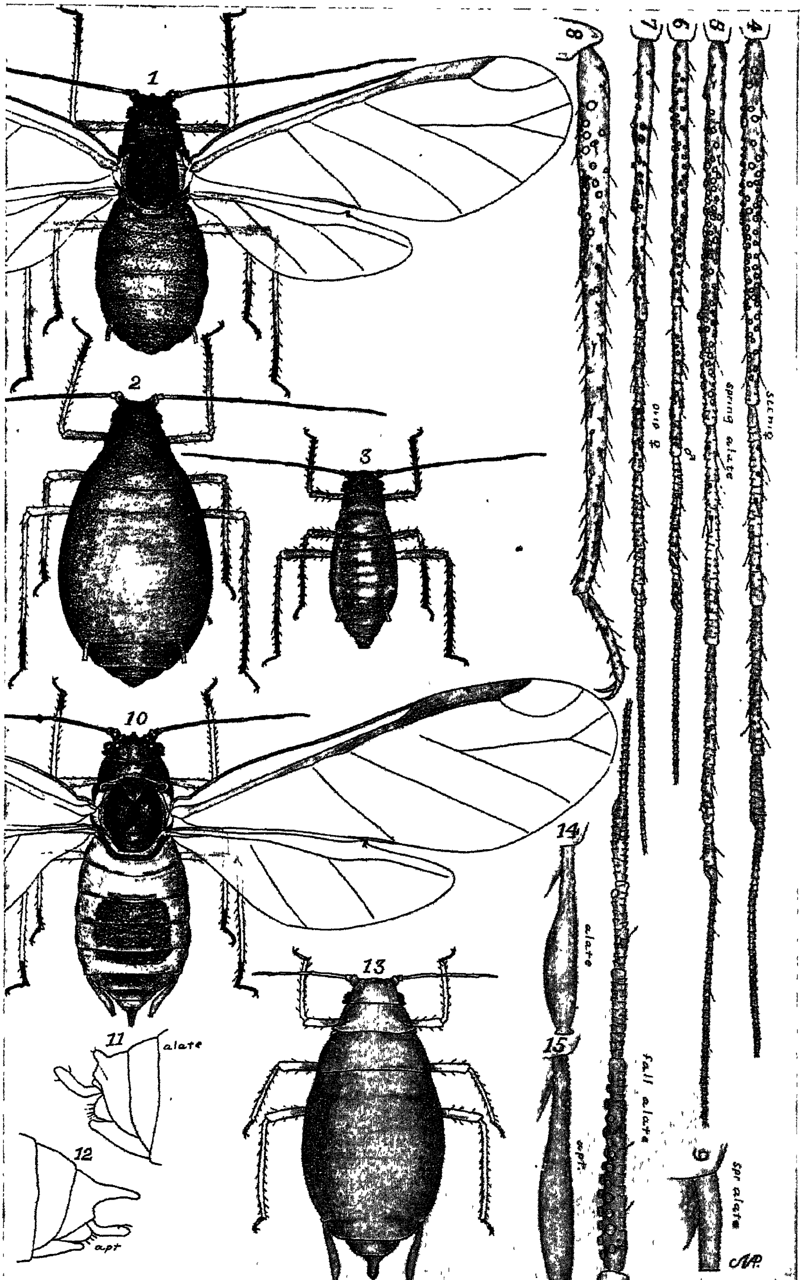
Male: Apterous, from stems at ground and on upper roots of *Symphoricarpos occidentalis*, taken at Fort Collins, October 15, 1910.

General color carneous, or yellowish brown; head, entire antennæ, cornicles, tarsi, and distal ends of tibiæ and femora black or blackish; eyes dark red.

Length 1.90 mm.; antenna 1.84 mm.; joints of antennæ: III, .60; IV, .36; V, .26; VI, .10; spur, .40 mm.

Antenna with a moderate number of short hairs; joint 6 tapers gradually into the spur; sensoria abundant on joint 3 and a few on joint 4.

Oviparous Female: Apterous and a little darker than the viviparous female, also smaller and more elongate. Cornicles concolorous with the body; entire body more or less heavily powdered above and below; length of body 3 mm.; cornicles weak, cylindrical, .24 mm. long, without flange; length of antenna 2.20 mm.; joints about as follows: III, .70; IV, .35; V, .31; VI, .14; spur, .44 mm. Tarsi, distal ends of tibiæ and most of distal portion of the antennæ black or blackish; hind tibiæ with numerous circular sensoria (or scent glands) on upper third of hind tibiæ.



Aphid Structures

Eggs pale yellowish, covered somewhat with the waxy secretion but only accidentally; deposited on the lower stems just beneath the surface of the ground.

We have been taking this louse for the past three seasons about Fort Collins and always on *Symphoricarpos* at or below the surface of the ground throughout the year. It seems to be a bark feeder exclusively. While this louse may not properly belong in the genus *Aphis*, it fits here as well as in any genus known to me.

Plate 9, Figs. 1 to 9, *Aphis pulverulens*; Figs. 10 to 16 *Rhopalosiphum capreæ*. 1, Alate; 2, apterous viviparous females; 3, male; 4, antenna of Fig. 2; 5, antenna of Fig. 1; 6, antenna of male; 7, antenna of oviparous female; 8, hind tibia of oviparous female; 9, cornicle of alate female; 10, alate viviparous female; 11, end of abdomen showing tubercle of the preceding; 12, the large tubercle or spine of the apterous female; 13, apterous female; 14 and 15, cornicles of alate and apterous females; 16, antenna of alate female.

Figs. 1, 2 and 3 are enlarged 14 diameters; 4 to 9 enlarged 60 diameters; 10 and 13, 20 diameters; 11 and 12, 40 diameters; 14, 15 and 16, 80 diameters. Original, Miss M. A. Palmer, Delineator.

LIST OF THE APHIDIDAE OF ILLINOIS, WITH NOTES ON SOME OF THE SPECIES.

(*Concluded from p. 496, Vol. 3.*)

By John J. Davis, *Office of the State Entomologist, Urbana, Illinois.*

[t]*Phorodon scrophulariæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 72. I have never seen this species, and it has only been recorded once since the original description, W. T. Clarke having reported collecting it in California on *Scrophularia* sp.[1] First reported by Thomas.

**Phorodon galeopsidis* Kalt.: What I consider this species and have described below was found quite common on *Polygonum pennsylvanicum* at Oak Park and Urbana from July to October. It doubtless occurs at other seasons on the same plant, but it has never been looked for other than in the months mentioned. It has not heretofore been recorded from America, although I surmise that the species referred to as *Siphonophora polygoni* by Thomas and Oestlund are this species. It colonizes on the under surface of the leaves, principally along the larger leaf veins. The oviparous female was not taken.

Winged viviparous female.—Head dusky (Pl. 10, fig. 3), thoracic plate dark olive, abdomen yellowish to yellowish green with a dark dusky green rectangular spot on the dorsum, which sometimes is only present on the two segments anterior to the cornicles, and a row of very faint dusky spots on each side of the abdomen.

[1] A list of California Aphididæ. Can. Ent. Vol. XXXV (1903), p. 252.

Antenna dusky to blackish, the two basal segments also dusky, but paler than the others; VI filament longest, it being about twice the length of the next longest segment (segment III), IV fully a third shorter than III, IV and V subequal, VI base about 2-5 the length of V or 1-8 the length of VI filament, total lengths about 1 1-2 times that of the body; III with 23–33 (usually 27 or 28) small but conspicuous, circular, irregularly placed sensoria, IV with 13–18, V with 1–4, usually in a row and the usual larger one at distal end, VI base with a large one surrounded by a number of minute ones at distal end. (Pl. 10, fig. 2.) Eyes red. Beak not reaching to coxæ of the second pair of legs. Wings with veins dark brown and distinct, third discoidal branching slightly nearer to the apex than to where the second branches. (Pl. 10, fig. 1.) Legs pale yellowish, excepting the joints, which are brownish, and the tarsi, which are black. Cornicles reaching beyond tip of abdomen, very slender, the basal two-thirds swollen, the distal third pale yellowish to greenish yellow and dusky at tips. (Pl. 10, fig. 4.) Style moderately long and slender, about a third the length of cornicles. (Pl. 10, fig. 5.)

Measurements.—Length of body, 1.8 mm.; width, 0.72 mm.; length of forewing, 3.0 mm.; width 1.25 mm.; antenna, I, 0.10; II, 0.065; III, 0.38–0.44, avg. 0.42; IV, 0.27–0.36, avg. 0.33; V, 0.245–0.31, avg. 0.28; VI, base, 0.09; VI, filament, 0.82–0.93, avg. 0.86; avg. total, 2.145 mm.; cornicles, avg. 0.42 mm.; style, avg. 0.145 mm.; hind tarsus, avg. 0.11 mm.

Wingless viviparous female.—Entire body pale yellow. Head and first antennal segment bearing several whitish capitate hairs. Antennæ whitish, about as long as body, relative lengths of segments as in winged viviparous female. Eyes dark red. Beak not reaching beyond coxæ of second pair of legs. Legs whitish. Cornicles and style whitish, otherwise as in winged.

Measurements:—Average, in mm. Length of body, 2.3; width, 1.07; antenna, I, 0.095; II, 0.06; III, 0.45; IV, 0.35; V, 0.29; VI, base, 0.085; VI, filament, 0.85; cornicles, 0.67; style, 0.19.

Winged male.—In relative measurements similar to the winged viviparous, differing from it as follows: head and thorax blackish, abdomen pale yellowish, with a slight faint orange tint, the longitudinal median dorsal red line which is so conspicuous in the pupal stage is faintly visible, and on each side of the median, extending longitudinally, are short dusky transverse markings, one or two of which are sometimes connected at the median line, thus forming single transverse bars on the respective abdominal segments. Entire body covered with a fine pulverulence. Antennæ black, and with circular sensoria irregularly placed as follows: III, 33–39; IV, 20–31; V, 8–13. Femur dusky to blackish, being paler at the base, tibia pale excepting black distal end, and tarsus black. Cornicles and style dusky and a black spot at the base of each cornicle.

The conspicuously marked immature male is at once distinguished from the pale yellowish young of the viviparous generations. It is characterized by a bright reddish longitudinal median dorsal line on a pale yellowish background, and extends the entire length of the body. In the adult pupa the line is not such a bright red, and the abdomen is more of a pale orange color.

**Macrosiphum asclepiadis* Cowen: Bull. Col. Agr. Expt. Station No. 31, Tech. Ser. No. 1, (1895), p. 123. A rather common species in Illinois, on *Asclepias* sp. This may have been one of the species

which Thomas seems to have confused in his description of *Siphonophora asclepiadis* Fitch.[1]

[d]*M. calendulæ* Monl.: Bull. Geol. and Geog. Surv. Vol. V, No. 1 (1879), p. 21. Mr. Monell (*loc. cit.*) determined specimens collected in Illinois as questionably this species. I am unacquainted with it.

M. cerealis Kalt.: Pergande, Bull. Div. Ent. U. S. Dept. Agr. No. 44 (1904), p. 18. I have been unable to separate this species from *granaria*, and although I believe the two synonymous, leave them distinct for the present. First reported by Pergande.

M. circumflexum Buck. (=? *Myzus vincæ* Gil.): Buckton, Monograph of British Aphides, Vol. I (1876), p. 130, col. figs.; Gillette, Can. Ent. Vol. XL (1908), p. 19, figs. What I consider this species is found in greenhouses in Illinois, and is often destructively abundant on dahlia, easter lily, *Vinca*, and maiden-hair fern (*Adiantum*). First reported by the writer.

***M. cratægi* Monl.: Bull. U. S. Geol. and Geog. Surv. Vol. V (1879), p. 20. I found this species common on the under surface of the leaves of *Cratægus* in the Chicago parks. It was not, however, sufficiently common to be injurious. I believe this species has not been reported since the original description by Monell. Prof. W. T. Clarke, in his "*List of California Aphididæ*"[2] lists *Aphis cratægi* Monl. from California. He doubtless had another species as Monell's *cratægi* is a true *Macrosiphum*. The antenna of the wingless viviparous female is shown in Pl. 10, fig. 6.

[t]*M. curcubitæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 67. Very common and sometimes destructive to squash vines. Usually, however, they do not become injuriously abundant until in the fall when the plants are fully matured, and fruit nearly ripe. First reported by Thomas.

M. cynosbati Oestl.: Davis, Annals, Ent. Soc. America, Vol. II (1909), p. 38, figs. Colonizes on tender terminal twigs and leaves of the common ornamental currant (*Ribes aureum*), often seriously stunting the growth. First reported by the writer.

[t]*M. erigeronensis* Thos.: Sanborn, Kans. Univ. Sci. Bull. Vol. III (1904), p. 76, figs. Common on *Erigeron canadense* throughout the state. First reported by Thomas.

[d]*M. fragariæ* Koch. var. *immaculata* Riley: Rural World, December 11, 1875. This variety was described by Doctor Riley in the Rural World, characterizing it as different from *fragariæ* Koch by the absence of black lateral abdominal spots in the winged female, and in

[1] 8th Rept. State Ent. Illinois, 1880, p. 58.
[2] Can. Ent. Vol. XXXV (1903), p. 250.

the head of the wingless being yellow.[1] Nothing has since been added to our knowledge of the species, though it has been mentioned in literature by several authors, excepting the notes made by Monell[2] from an examination of a single winged specimen in Riley's cabinet,

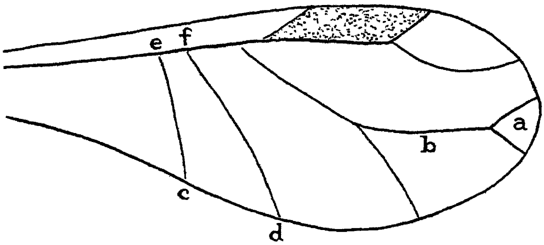


Fig. 10. Sketch of wing of *M. fragariæ* var. *immacullata* Riley [After Monell].

and by Mr. Theo. Pergande[3] who, after examining the few poorly preserved specimens (probably pinned) of Riley's *immaculata*, states that his *Macrosiphum trifolii* is distinct. Nor has it been identified since the original description, and it is probable that the species referred to by Riley as *immaculata* is some other—possibly *A. forbesi.* Mr. Monell has very kindly placed at my disposal the original notes which he made August 21, 1876, from a specimen in Riley's collection. They are as follows:

"62° Cell formed by secondary branches of cubital very small (a). The upper branch in *S. fragariæ* Koch (see pl. XXXII Pflanzenlause) being quite equal in length to part marked *b* in explanatory sketch. The first and second discoidal are almost parallel in Koch's figure [while in *immaculata*] space at apices [*c d*] is little over twice as wide as space at bases [*e f*]. Hind wings have apex more pointed than in Koch's figures. It has two discoidals, costal vein seems rather straight. Little (hooks) protuberances upon costal edge (Koch's figure does not show costal edge). Drawn from dried specimen in Mr. Riley's cabinet under small lens August 21, 1876."

The drawing referred to by Mr. Monell is only 13 mm. in length, and I have drawn free-hand (fig. 10) a reproduction which, for the purpose here intended, is sufficiently accurate. The venation agrees quite well with *Aphis forbesi* Weed,[4] but differs from that species in lacking the black lateral abdominal spots. Although these notes are insufficient to draw any reliable conclusion, they are given with the hope that they may later be a help in a solution of the problem. This species has never been positively reported from Illinois.

†*M. gerardiæ* Thos.: 8th Rep. State Ent. Ill. (1880), p. 66. This species has not been reported since the original description.

[1]Mr. J. T. Monell, in a letter dated December 7, 1910, writes: "There is no formal description, but simply what Thomas gives in his Illinois report. I may note that Riley did not at that date know a *Siphonophora* from an *Aphis*."

[2]Bull. U. S. Geol. and Geog. Surv., Vol. V (1879), p. 22.

[3]Bull. U. S. Depart. Agr., Div. Ent., No. 44 (1909), p. 22.

[4]The venation of *forbesi*, however, varies considerably.

M. granaria Buck.: Pergande, Bull. Div. Ent., U. S. Dept. Agr. No. 44 (1904), p. 14, figs. The most common and generally distributed grain louse in Illinois, but seldom injurious. First reported by Pergande.

M. lactucæ Schr.: Thomas, 8th Rep. State Ent. Ill. (1880), p. 60. What is doubtfully referred to this species is common on cultivated lettuce in greenhouses, where it often is a nuisance of considerable importance. We have also taken it on celery out-of-doors.

Winged viviparous female.—Head (Pl. 10, fig. 7) and thoracic shield jet black. Abdomen pale green with blackish markings as shown in figure (Pl. 10, fig. 8). These markings vary considerably in size, but the figure is typical. Eyes dark red to blackish. Antennæ black; more than a third longer than the body; segment VI filament longest, it being more than twice the length of III, IV and V subequal and each about two thirds the length of III, VI base about one fourth length of IV or one twelfth of the filament; segment III with 40 to 50 irregularly placed circular sensoria; segment IV with 7 to 11 in a row; V with the usual one at distal end, and VI base with the usual distal one surrounded by several smaller ones (Pl. 10, fig. 9). (In two examples, both from same individual, segment III had but 27 and 28 sensoria, and IV but 2 and 3, respectively.) Beak reaching coxæ of second pair of legs, the tip black. Wings with brownish venation (Pl. 10, fig. 10). Cornicles black, reaching to or slightly beyond tip of abdomen. Style dusky or brownish to blackish, about half the length of cornicles.

Pupa.—Entirely pale green. Eyes black. Antennæ with segments I, II, and basal portion of III concolorous with body, remaining segments darkening to brown, the last segment black. Legs with femur pale greenish, tibia pale brownish, and tarsus black. Cornicles dusky. Style green.

Wingless viviparous female.—Head and body green, varying from pale to dark. Antennæ a little longer than body; segment VI filament longest, it being from a third to a half longer than III, IV and V subequal, IV, however, invariably slightly the longer, VI base short, it being only about one ninth or one tenth the length of filament; segment III with 24 to 30 irregularly placed circular sensoria which are much more thickly placed on the basal two thirds of the segment; pale green with the joints, distal end of V, and VI blackish. (Pl. 10, fig. 11.) Cornicles cylindrical, concolorous with body, the tip being blackish, reaching to tip of body, twice the length of style and about four fifths the length of antennal segment III. Style concolorous with abdomen.

M. liriodendri Monl. and var. *rufa* Monl.: Davis, Annals, Ent. Soc. Amer. Vol. II (1909), p. 36, figs. I have found this species at Urbana, Galesburg and other central Illinois cities, where it is common on the *Liriodendron tulipifera.* First reported by the writer.

[t]*M. minor* Forbes: 13th Rep. State Ent. Ill. (1884), p. 101. First reported by Forbes.

M. rosæ Linn: Thomas, 8th Rep. State Ent. Ill. (1880), p. 50; Oestlund, Bull. Geol. and Nat. Hist. Surv. Minn. No. 4 (1887), p. 81. A common and annoying pest of garden roses. First (doubtfully) reported by Thomas.

[d]*M. rubi* Kalt.: Thomas, 8th Rep. State Ent. Ill. (1880), p. 64. Supposedly Thomas's observations were made in Illinois, although he does not so state. The species has not since been reported, and is questionable if it occurs in the United States.

M. rudbeckiæ Fitch: Thomas, 8th Rep. State Ent. Ill. (1880),

p. 49; Weed, Psyche Vol. 5 (1889), p. 127. A very common species in Illinois, it being especially noticeable on cultivated lettuce, *Lactuca scariola*, cultivated garden aster, *Aster drummondi*, and *Ambrosia trifida*. First reported by Thomas.

M. sanborni Gil.: Can. Ent. Vol. XXXX (1908), p. 65, figs.; Sanborn, Kans. Univ. Sci. Bull. (1904), p. 73, figs. (*M. chrysanthemi.*) One of the most common and destructive pests of chrysanthemum, both in greenhouses and out-of-doors. First reported by the writer.

**M. solanifolii* Ashm.: Patch, Bull. Me. Agr. Exp. Sta. No. 147 (1907), p. 251, figs. Although not commonly and generally a pest of the potato in Illinois, I have occasionally found it exceptionally and injuriously abundant.

[d]*M. tanaceti* Linn.: Although Thomas mentions this species in the Eighth Illinois report, there is no indication that he actually found it.

**M. tiliæ* Mon.: Bull. U. S. Geol. and Geog. Surv. Vol. V (1879), p. 20. I have taken this rare species on two occasions on the under sides of linden leaves in the Chicago parks.

M. trifolii Perg.: Bull. Div. Ent. U. S. Dept. Agr. No. 44 (1904), p. 21, figs. First reported by Forbes.

M. ulmariæ Schr. (*pisi* Kalt.): Sanderson, Can. Ent. Vol. 33 (1901), p. 31. Common in Illinois on red clover (*Trifolium pratense*), white sweet-clover (*Melilotus alba*), sweet peas and garden peas, it being especially destructive to the two last mentioned. First reported by Thomas.

[t]*M. verbenæ* Thos.: Bull. Ill. State Lab. Nat. Hist. Vol. I, art. 2, p. 8. This species has not been reported since the original collection. First reported by Thomas.

[t]*M. viticola* Thos.: 8th Rep. State Ent. Ill. (1880), p. 55. A common grape louse, often exceedingly abundant. First reported by Thomas. See discussion under *Aphis illinoiensis*.

ADDENDA.

**Rhopalosiphum poæ* Gillette.—Can. Ent. Vol. XL. (1908). p. 61, Figs. 10. Wingless adults, immature and pupæ were found abundant on blue grass (*Poa pratensis*) at Aurora, Ill., November 14, 1910. Found in sheltered places, under conditions almost identical with those reported by Professor Gillette. (*loc. cit.*)

Hyadaphis pastinacæ Linn.—Since writing on this species (see page 493 of the JOURNAL, Vol. 3) Prof. O. W. Oestlund has kindly examined his *Siphocoryne archangelicæ* and in a letter of December 19, 1910, he says that it has the dorsal tubercles and is doubtless the same as *H. salicis* Monl. He further states, "What I take to be a

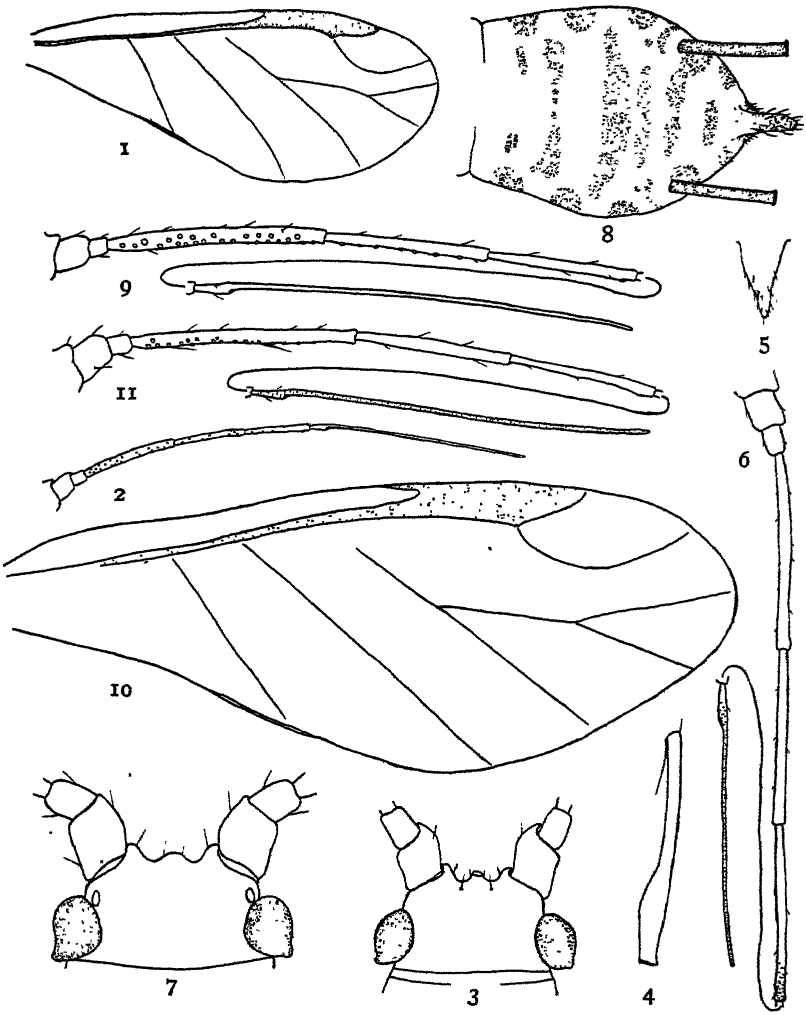


Plate 10. Aphid Structures

typical *S. pastinacæ*, that I collected at Vancouver some years ago, is so similar to our material that the three are no doubt the same.

Explanation of Plate 10.

Phorodon galeopsidis Kalt.—Fig. 1, wing; 2, antenna; 3, head; 4, cornicle; 5, style of winged viviparous female.

Macrosiphum cratægi Monl.—Fig. 6, antenna of wingless viviparous female.

Macrosiphum lactucæ Schr.—Fig. 7, head; 8, abdomen; 9, antenna; 10, wing of winged viviparous female; 11, antenna of wingless viviparous female.

Camera lucida drawings, figures 3, 4, 5, and 7, with one-inch eye piece and two-third objective; 2, 8, and 10 with one-inch eye piece and one and a half inch objective; 6, 9, and 11 with a two-inch eye piece and two-third objective; 1 with a two-inch eye piece and one and a half inch objective.

NOTES ON THE EGG-LAYING HABITS AND EMERGENCE OF ADULT OF SANNINOIDEA EXITIOSA SAY

By E. N. Cory, *College Park, Maryland*

In the course of studies of the life history of *S. exitiosa*, several interesting features of the egg-laying habits and emergence of an adult were observed.

The method of procedure in this work was as follows:

Pupæ were collected and bred out in confinement and the moths thus secured were introduced into cages, placed over two-year-old nursery stock. The cages were specially constructed for this work, being large enough to allow the investigator to work within the enclosure. (Pl. 11, Fig. 1.)

The cages were erected in the field on June 22, 1910, but it was not until July 11 that observations were recorded.

Records:

Female No. 1. July 11. At 8.30 a. m. one male and one female moth, number one, bred in confinement, were introduced into cage A. At 9.45 a. m. two more males, bred in confinement, were introduced. No attempt at copulation was made by these males. At 10.10 a. m. one male was observed flying around the outside of the cage near the female, who was resting on the wire with the tip of her abdomen elevated and genitalia protruded. This male was captured and introduced into the cage. He flew at once to the female and copulation began at 10.13 a. m., the pair remaining in coitu until 11.05 a. m. They settled on one of the uprights, with heads in opposite directions.

July 12. All moths caged on July 11 escaped from cage A, owing to a screw pulling loose. This was remedied.

Female No. 2, July 12. At 11.15 a. m. four males and one female, number two, bred in the insectary, were placed in cage A. By 12.15 p. m. four males had visited the cage. Three of these were caught and put into the cage. The female during this time had her abdomen curved upward and the genitalia extended. At 12.23 p. m. copulation took place, but whether with one of the males bred out or one of the visitors, I am unable to say. The female remained stationary as before, the male hovering near until finally able to clasp the female. The two triangular tufts of hairs on the male's abdomen apparently clasped the female along the sides of the abdomen and the anal tuft of the male was above the tip of the abdomen of the female. They remained in coitu until 1. 23 p. m., male head down.

July 13. From 6.30 to 9 a. m. female number two was sluggish and in the grass; from 9 to 11 a. m. she was on the wire of the cage and from

11 a. m. to 3.10 p. m. she was on the peach foliage. At 1.45 she began to gently swing the tip of her abdomen, with ovipositor extended, from side to side, occasionally touching the leaf on which she stood. At 1.56 she deposited her first egg; at 2.09 the second; the third at 2.15 and the fourth at 2.22. She then ceased ovipositing for the day. One male left overnight in the cage.

July 14. At 11.29 a. m. female number two was resting on leaves with genitalia exserted, and one male appeared, which was captured and introduced. At 11.39 a second male appeared at the cage. At 11.51 two more males came to the cage, at the same time the female deposited one egg. At 11.53 one male was allowed to enter the cage and he immediately copulated with female number two, remaining in coitu until 12.44. At 12.46 the female began ovipositing, laying five eggs by 1.01. The remainder of the day she rested on the side of the cage.

July 15. Female number two alive, resting on ground. At 2.30 p. m. she was dead. She deposited twenty-one eggs on the peach leaves. Quite a mass of eggs were in the body, which was mutilated by ants.

Female No. 3, July 13. One female, number three, emerged between 9 and 11 a. m., and was placed in cage B, surrounding four trees, at 11 a. m. At 11.45 she took up a position on a side of the cage, raised her abdomen and extended her genitalia. At 11.56 one male appeared; failed to catch same. At 12.01 p. m. two males appeared; one was caught and placed in the cage. At 12.04 another male appeared; was caught and placed in the cage; at 12.06 a fourth male and at 12.15 a fifth, but neither was caught. At 12.17 female number three copulated with one of the males, remaining in coitu for an hour. At 1.30 the female began ovipositing, two eggs being delivered between 1.30 and 1.40. She then ceased ovipositing for the day. In copulating the male flew at female, waiting with abdomen elevated and genitalia extended, and repeatedly darted the tip of his abdomen at the female, finally joining and turning. The female retained her hold on the cage; the male vibrating its wings rapidly for a time, finally settling on the cage, head down.

July 14. Three males left overnight in cage B. Flight of female heavy. At 3 p. m. female number three began ovipositing again.

July 18. Female number three gone, presumably dead and eaten by ants during the night. She deposited 21, 30, 25, and 85 eggs respectively, on the four trees. Largest number of eggs in one cluster nine; largest number on one leaf twelve.

These results were contrary to any account of the egg-laying habits that the writer had seen and believing that they might be influenced

by the artificial conditions, another condition was supplied in this manner. A peach tree about ten years old having plenty of foliage and a heavy trunk was cut back to permit one of the cages being placed over the tree. This, then approximated natural conditions in every way except that the moth number four was in confinement (Plate 11, Fig. 2).

July 27. All eggs hatched in cage B. The hatching occurred either during the night or very early morning and was not observed; the larvæ emerged from the micropyle end, cutting out the entire end in small sawdustlike particles. Cage B was then moved over four other trees.

Female No. 4, July 25. At 9 a. m. two females, numbers four and five, and one male were put in cage C. At 9.55 two males were flying about the cage, one of which was caught and introduced; at 10.15 a second visiting male was placed in the cage and at 10.22 a third was secured. At 10.24 one pair was in coitu, remaining on the branches and leaves until 11.45 when they separated. At this time female number five, not having copulated, was removed from the cage. In this case, as before, the males appeared only when the female extruded her ovipositor, flying away when she sheathed same. At 1 p. m. two eggs were found on a bark scale just above the ground and one egg about eighteen inches above.

July 26. Female number four not in the cage, presumably died and was eaten by ants. She deposited fifty-six eggs on the leaves and twenty-three on the trunk.

August 4. Seven eggs in cage C hatched between 4.30 p. m. August 3d and 7.30 a. m., August 4th. Larvæ could not be found, even with the aid of a large reading glass.

August 5. Cage C was watched carefully until dark on the 4th, but on visiting the cage at 7.30 a. m. on this date, all eggs were hatched.

Female No. 5. This moth was not used.

Female No. 6, July 27. At 1.30 one female, number six, was introduced into cage B with one male. At 2.10 one male appeared; at 2.15 one male was introduced; at 2.45 another male was introduced and at 2.50 a fourth male was placed in the cage. No copulation.

July 28. At 11 and 11.30 males were placed in cage B. At 11.40 a pair were in coitu, separating at 1 p. m.

July 29. Forty-two eggs on the trunk of one tree in cage B, the first egg eight inches from the ground; last about eighteen inches. Sixteen eggs found on the leaves.

August 1. Female dead. She deposited a total of ninety-seven eggs, forty-two of which were on the trunk and fifty-five on the leaves.

August 1. Eggs on trunk of tree in cage B had their top half eaten

off. A coccinellid (*M. maculata*) found in this cage was brought into the laboratory and placed in a cage with leaves having eggs of *S. exitiosa* on them. The beetle did not eat any of the eggs.

August 1. Nine more eggs in cage B eaten. No insect found that could have done the damage.

August 9. Two eggs in cage B hatched during the time between sunset and 8 a. m. the following morning.

August 10. All remaining eggs in cage B hatched during the interval between sunset and 7 a. m.

Female No. 7, July 28. Female number seven placed in cage A at 10.05 and males placed with her at 11.00, 11.25 and 11.45.

July 29. Twenty-one eggs found in cage A.

August 1. Female number seven dead. She deposited seventy-five eggs, 47 of which were on the tip of one leaf, overlapping both sides.

August 13. No eggs in cage A hatched.

Female No. 8, September 10. Owing to the fact that no more moths emerged in the insectary work was discontinued but on this date two females emerged from the old tree in cage C and on August 12 one of these, number eight, was transferred to cage A. The other was held in reserve.

September 12. One female placed in cage A. At 12 a visiting moth was introduced into the cage and at 12.06 copulation took place, lasting an hour.

September 13. Twenty-two eggs deposited by female. She afterwards became entangled in a spider web and died.

September 29. All eggs in cage A hatched between 6 p. m., August 28, and 9.30 a. m., August 29.

Summary

In all cases, the males appeared only when the females exserted their genitalia and it was notable that the former came to the cages almost immediately following the protrusion of the ovipositor. As far as could be ascertained, no sound was produced by the female. In all cases except one, only the captured, visiting males copulated with the females. In the exception noted, so many males were in the cage that this point could not be determined.

In copulating the females rested on the cage or leaves with genitalia exserted; the male hovered near, darting the tip of his abdomen toward the female until finally able to clasp her genitalia. He then turned with his head in the opposite direction to hers and settled on the same object that supported the female. The shortest period of copulation was fifty-one minutes; the longest eighty-one minutes and the average sixty-five minutes and forty-five seconds. However, in one case the

female was fertilized twice, the day she was introduced and the succeeding day. The time between the fertilization and the oviposition varied between wide limits. In some cases the females oviposited within a few minutes of fertilization, and again the interval was over twenty-four hours.

During oviposition, the female arched the center of her abdomen upward, the tip pointing downward and extended the ovipositor. Then she began to swing her abdomen gently, from side to side, occasionally pausing to touch her ovipositor to the leaf. Each egg was deposited singly and glued to the leaf by a secretion placed on the leaf before delivery of the egg. The eggs are brown, regularly oval, and average .823 mm. x .542 mm. The micropyle end is heavily indented. The shell is net-veined. Plate 11 Fig. 3 shows the eggs, almost natural size, on the leaf. The greatest number of eggs deposited by one moth was 161. The greatest number in one place 147. Of all eggs deposited 390 were placed on the leaves and 65 on the trunk. The shortest period of incubation was 10 days; the longest 16 1-2 days (in September) and the average 13 days. All larvæ emerged from the micropyle end cutting it away in small sawdust-like particles.

Emergence of a Moth

On entering the insectary at 8.30 a. m., July 21, one pupa, collected on July 20 was found half above ground in the flower pot in which it had been placed. Taken into the sunlight at 9 a. m. it began, after a few minutes, to twist on the tip of its abdomen as a pivot until about three fourths above ground. After a short rest the insect began pushing upwards by successive contractions and expansions of the abdominal segments until the pupa case split along the back a short distance and down the front between the wing and antennal cases. Continuing the motion the insect gradually withdrew its body. The antennal and proboscis cases split on their inner side, *i. e.*, the side next to the body.

The adult proved to be a male. It rested on a lump of dirt with wings against its sides for several minutes. Wings were then opaque. He gradually arched the anterior wings, separating them from the posterior pair. After having separated them he lowered the anterior pair until in contact with the posterior wings and then raised both sets until their upper surface touched above the back. They were held in this position about five minutes, the opaqueness gradually clearing and the veins becoming outlined with yellow. After five minutes the wings were lowered to the body with the costal margin of the anterior wing at about 45° to the body, in a horizontal plane. After about ten minutes in this position the moth was ready for flight.

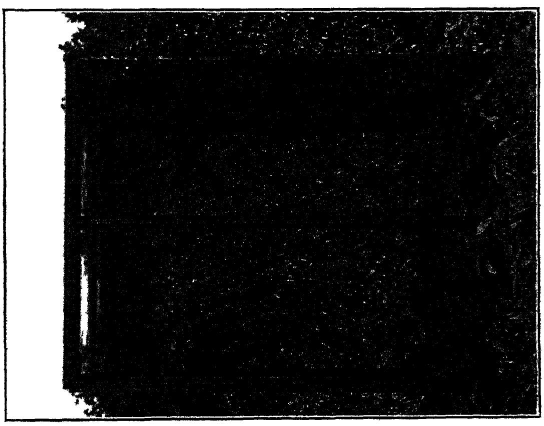


Fig. 1.

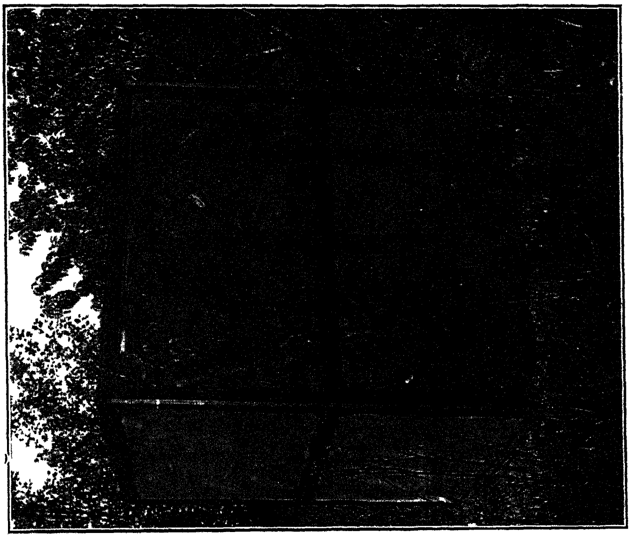


Fig. 2.

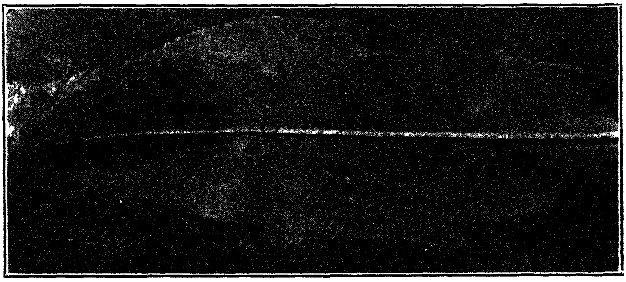


Fig. 3.

Fig. 1, large cage over nursery trees; fig. 2, small cage over dehorned tree; fig. 3, leaf showing eggs, slightly reduced

NOTES ON THE RED SPIDER ATTACKING COTTON IN SOUTH CAROLINA[1]

By H. F. Wilson,

Oregon Agricultural College, Formerly Entomological Assistant, Bureau of Entomology, United States Department of Agriculture.

During the spring and summer of 1910 the writer, while an assistant in the United States Bureau of Entomology, worked under the direction of W. D. Hunter, in charge of Southern Field Crop Insect Investigations, at Batesburg, S. C., for the purpose of investigating red spider injury to cotton. At that time *Tetranychus gloveri* Banks was supposed to be the pest in question and a project was planned under that head. Later developments proved that *Tetranychus bimaculatus* Harvey was the real pest. The circumstances which lead to this conclusion will be given below.

With the idea of locating the winter stages of *T. gloveri* a number of procedures were attempted. All evergreens and perennials were examined, the first to find the plants upon which the mites might remain feeding over winter and the second to locate the winter stages about the roots. *T. bimaculatus* was found February 5th in all stages upon the under side of leaves of a bush (*Thea japonica* L.) in a dooryard. A little later in the spring they were found on wild blackberry canes and on cultivated violets. Little attention was paid to this species at that time as *T. gloveri* was supposed to be the pest. By May first, this species not having been located and *T. bimaculatus* being very abundant on a number of weeds as *Chenopodium botrys* and *Datura* sp. as well as on cotton, plans were made to carry on life history work with the second species. These notes cover a period of from May 6 to August 16.

Mites were transferred to potted cotton plants and these were set in the insectary so that other mites could not reach them. From time to time these mites were examined to determine whether they were *T. gloveri*. They were all determined as *T. bimaculatus* by Mr. Nathan Banks of the United States Bureau of Entomology. Single leaves of *Chenopodium botrys* were used to carry on the work as they would not wilt for from twelve to fourteen days when carefully handled. In cases where the leaves wilted it was found that the mites would migrate to fresh leaves and so each vial holding a single leaf was placed in holders which were entirely surrounded with water.

T. bimaculatus began to appear abundantly on cotton in the fields

[1] Published by permission of the Chief of the Bureau of Entomology of the United States Department of Agriculture.

and later investigations throughout the state proved that this species and not *T. gloveri* was doing a great amount of damage. Now the question arises as to which species is really the cotton red spider. My observations show that in 1910 in South Carolina the damage to cotton was altogether by *T. bimaculatus.* In fact that was the only species of Tetranychus found upon any plants.

Regarding *T. bimaculatus,* which I have collected in South Carolina, District of Columbia, Illinois, and Oregon, and which has been reported from Maine, Florida, Colorado, etc., the probability arises that this mite belongs to one of the several common European species. There seems a great likelihood that it has been gradually spread over the United States by greenhouse plants in the southern states, especially by violets, which are favorite ornamental plants for dooryards. They remain green throughout the year and afford a fine winter shelter for the mites. Mr. Banks (Proc. Acad. Nat. Sci., Phila., 1901, p. 596) has, in fact, pointed out that this was probably the way in which the mite was introduced into New Mexico.

The eggs are not deposited in masses on the leaves but usually within a certain area. Oftentimes the female will leave the original starting place and so form two colonies on the same leaf. Probably in every case a web of fine silk-like threads will be found over the eggs with occasional eggs in the web. The eggs when first deposited are like clear drops of water but soon turn reddish and sometimes become dark red. Upon hatching the young mites are colorless, very hard to see, and have but three pairs of legs, the fourth pair appearing after the first molt.

Shortly after hatching the very small mites appear dark green and are so near the color of the leaf that only continued search will reveal them. The first molt takes place in about two days after hatching and after that one can hardly note the molts on account of the presence of the cast skins of the young. There seems to be four molts between eggs and adult. When ready to molt the fourth time the mites are probably full grown and they do not increase in size after molting the last time.

They probably go down to the crown of the plant during cold weather, migrating back to the leaves with the return of rising temperature. From these they migrate to other plants and into cotton fields where they create great havoc in a very short time.

In making notes on life history single females were placed on individual leaves. These records show that in May the length of the egg stage is greater than during the months of June and July, the maximum number of days from deposition to hatching being sixteen and the minimum seven, average thirteen. During June the

maximum was six and the minimum three, average four and one-half. During July the maximum was five and the minimum two, average three and one half. In August two days seemed to be general'y required.

From individual counts it was found that the average number of eggs deposited in May was twenty while in July and August it was twenty-five to thirty.

Very soon after molting the last time the adults began laying eggs and from two to six were deposited each day until toward the last when a day or two passed without eggs being deposited. The life of the adult averaged about fifteen days, a'though one individual lived for twenty-six days. The average time required to reach the adult stage after hatching was twelve days, w'th the maximum twenty-two and the minimum seven.

THE CALIFORNIA CHRISTMAS-BERRY TINGIS

By C. PEMBERTON, *Stanford University, California*

The plant that takes the place in California of the holly of the East, as far as this place can be taken at all, is the so-called Christmas-berry, *Heteromeles arbutifolia*. By the first of December the shrubby bushes of this native plant are laden with firm, bright-red berries which are not at all unlike the holly-berry in appearance and are much used for holiday decoration. But not every year are the berries well developed and bright and in any year not all the bushes are equally strong and fruitful.

Among the causes for these failures of the bushes to reward the berry-gatherer, a small sap-sucking insect is not the least important. This insect may be called the California Chirstmas-berry tingis.

It is probably the same species as the Eastern hawthorn tingis, *Corythuca arcuata*, but it differs from this Eastern form so plainly and constantly by its paler color and disappearing pattern spots that it must certainly be recognized as a distinct variety of the species.

The species is common on hawthorn in the eastern United States and also on the apple and hawthorn in western Washington where it is probably an introduced insect.

The presence of the pest on the Christmas-berry can easily be detected by the brown, sun-burned appearance of the under sides of the leaves. This drying and mottling are due to the punctures and loss of sap and also to the presence of the excrement and dried cast-skins of the nymphal stages. When the attack is a bad one, as it often is

on some of the bushes on the university grounds, the entire foliage is given a brown unhealthy color, strikingly different from the live green of the uninjured plants. There are few Christmas-berry bushes in the Santa Clara Valley that escape the attack of this insect. The pest is also found occasionally and sparingly on the live oak, *Quercus agrifolia,* where the trees are close to Christmas-berry bushes.

The life history and habits of the insect have been studied by me through the present year (1910) and may be described as follows:

The adult female begins egg-laying about the middle of March. This year the first observation of the egg was on March 13. The eggs for the first twenty-five or thirty days are laid in thin groups of from four to eight. They are always laid upon the under surface of the leaf. By the middle of April, however, the vitality of the female seems greater, for eggs are laid in larger numbers. Close, compact groups of from fifteen to twenty eggs, all laid by the same female, are common.

The eggs are whitish and glistening, oval in shape, and average about .3 mm. in length. One end is broader than the other. The egg is deposited on the broad end and inserted upright into the leaf tissue, the broad half being beneath the surface of the leaf and fitting snugly into an incision made by the ovipositor. It is then completely covered by a brown sticky substance which hardens soon after oviposition. The summit of the cone-like mound thus formed is squarely truncate. The top is porous and forms a lid which comes off when the nymph issues. A group of such bodies from which the nymphs have issued look not a little like a number of minature volcanoes with crater-like openings at the top. A careful study was made of the incubation of the egg. It was found to vary from thirty-one to forty-seven days, depending upon the amount of sunlight, wind, temperature, etc. These observations were made upon many groups of eggs in different localities about the University, which were subject to different local conditions.

Nymph, Stage I. The first nymphs seen in 1910 hatched on April 12. They are oval, wingless, of a dirty brown color, and nearly the entire body is covered with short spines. They are very sluggish, not moving from the leaf on which they were hatched, and having a strong tendency to remain close together with their heads pointing toward a central spot. A group of from fifteen to twenty nymphs always actively feeding will discolor a fresh, green leaf in a short time with their excrement and the little white mounds made by the continual puncturing for food.

The nymph moults five times and gradually increases in size from .6 mm. (length of first stage) to 2.6 mm. (length of adult).

The nymph of the first stage is .6 mm. long, by .24 mm. wide. It is ovoid in shape. The legs and antennæ are stout, the legs about one half the length of the body and the antennæ a little shorter. The antennæ are three-segmented and covered with short spines, the third segment being twice as long as the first and second combined.

Each body segment bears on its lateral margin, a long spine, with a heavy conical base, secreting at its tip a transparent viscous fluid. About twenty more of these spines occur on the dorsal surface of the body, distributed as follows: two at the anterior tip, two pairs on the posterior portion of the head and ten or twelve scattered over the dorsal surface of the last five abdominal segments. The facets of the compound eye were always four in number in this stage.

Nymph, Stage II. Length .8 mm., width .53 mm. This stage is much broader in proportion to its length than in the first stage. The legs are slightly less club-like and stocky. The large spines on the dorsal marginal portions of the body have become considerably changed. Their bases have become greatly elongated, are tubular in form and compose over one half the length of the spine. The facets of the compound eye in this stage are five in number.

Nymph, Stage III. Length .96 mm., width .54 mm. The length of the third antennal segment is a little greater in proportion to the combined lengths of the first and second segments than in the preceding stage. The body is slightly longer in proportion to the breadth than in the preceding stage. A small secondary spine has appeared near the base of nearly all the large dorsal and marginal spines. The first and second body segments behind the head are slightly broader and are longer laterally than in the preceding stage. The facets of the compound eye are generally seven in number in this stage.

Nymph, Stage IV. Length 1.5 mm., width .7 mm. The general form is similar to that of the third stage. The antennæ are four segmented, the third segment being a little longer than the fourth which is about the length of segments one and two combined. The antennæ are still about the same length compared with the length of the body, as in stages one, two and three. The prothorax and mesothorax are much broader laterally, each being about three times as broad as long. The spines at the lateral margins of these two segments in this stage are about twice as numerous as in the other segments. The prothorax tapers posteriorly a little. The actual wing pads are first seen in this stage and are modifications of the second body segment posterior to the head. They extend posteriorly to the middle of the second abdominal segment, the posterior extensions being confined to the lateral portions of this segment. The spines are unchanged. The facets of the compound eye are greatly increased in number.

Nymph, Stage V. Length 2 mm., breadth 1.2 mm. The first two segments of the antennæ are equal in length. The fourth segment is equal to the combined lengths of segments one and two. The third segment is a little more than twice the length of the fourth segment. The legs are thinner and longer in proportion to the size of the body than in the preceding stages. The prothorax is half as long as broad, with the median anterior portion elevated. The wing pads extend to the anterior margin of the fifth abdominal segment.

Adult. The adults, male and female, can be easily distinguished without the aid of a lens. The tapering, bluntly-pointed abdomen of the male distinguishes it readily from the regularly rounded abdomen of the female. Another very distinctive feature of the male abdomen is the presence of a pair of large forcep-like claspers situated at the posterior tip.

The ovipositor of the female is concealed in a short, longitudinal groove on the under side of the abdomen at the posterior tip. The sides of the eighth abdominal segment overlap it, almost concealing

it. The ovipositor consists of a basal pair of plates joined along their inner edges and forming a sheath for the two cutting blades which are serrated on the outer edges, and adapted for cutting the leaf tissues, preparatory to the deposition of the egg.

Here in the Santa Clara Valley the adults hibernate only for a short period, depending upon the severity of the winter. They hibernate about the food plant under fallen leaves, under sticks, clods, stones, etc., and in secluded places on the trees such as curled leaves and cracks in the bark. They are not active upon the tree until about the middle of February. They then come out in considerable numbers and feed, usually in pairs, upon the under surface of the leaf. This year (1910) the first appearance of the adult was February 16. It is particularly interesting to note that this insect always feeds on the under surface of the leaf. Adults placed on the upper surface always move to the under surface immediately. The adults very seldom fly, and hardly ever leave a small branch on which they are feeding. They usually attack that portion of a tree most exposed to sunlight and are particularly common on the young new shoots about the base of the tree.

Broods. There are several broods in a year though it has not been determined whether the number is definite or whether it varies, according to climatic conditions. Under normal conditions here in the Santa Clara Valley the average life cycle is passed in about seventy-eight days. As the period of activity lasts about eight months, it seems very probably that there are but three broods a year. The greatest activity is in the summer months. By the first of November this year (1910) egg-laying had ceased, and at present (December) very few nymphs can be found while most of the adults have either died or hibernated.

A record was kept on several groups of nymphs to determine the duration of each stage. The average results were as follows:

Time elapsed between hatching of

Egg to 1st moult	8 days.
1st moult to 2d moult	6 days.
2d moult to 3d moult	7 days.
3d moult to 4th moult	7 days.
4th moult to 5th moult	11 days.

Injuries. As before stated the damage to the bush is considerable, but seems never fatal. About the university, probably much more damage to this bush results indirectly from the attack of the tingis, for a black smut or fungus (*Capnodium heteromeles*), the spores of which readily grow in the honey-dew excreted in large quantities by

the nymph, gains a strong foothold on most of the bushes and almost smothers them.

Remedies. The only remedy that can be given from actual observation here is that of intensive cultivation and cleaning up of rubbish about the bases of the trees during the period of hibernation, from December to March, of the adult. Trees about the university which have received little or no cultivation for the past two years were usually much more vigorously attacked by the tingis than those receiving regular winter cultivation. Where spraying has been attempted, success has resulted from the spraying of kerosene emulsion freely on the foliage, using an under spray nozzle.

This paper was prepared in the Entomological Laboratory of Stanford University.

EXPLANATION OF PLATES 12–14

Fig. 1. Egg on surface of leaf.
2. Same with portion of covering removed.
3. Same removed from leaf showing secondary covering (a).
4. First stage of nymph.
5. Second stage of nymph.
6. Third stage of nymph.
7. Fourth stage of nymph.
8. Fifth stage of nymph.
9. Adult.
10. Labrum of adult.
11. Mandible of adult.
12. Maxilla of adult.
13. Labium of adult.
14. Ventral aspect of last two abdominal segments of male. (a) clasper.
15. Ventral aspect of last three abdominal segments of female. (b) ovipositor.
16. Ovipositor removed—lateral view.
17. Cutting blade of ovipositor removed—lateral view. (c) cutting edge.
18. Wing of adult.

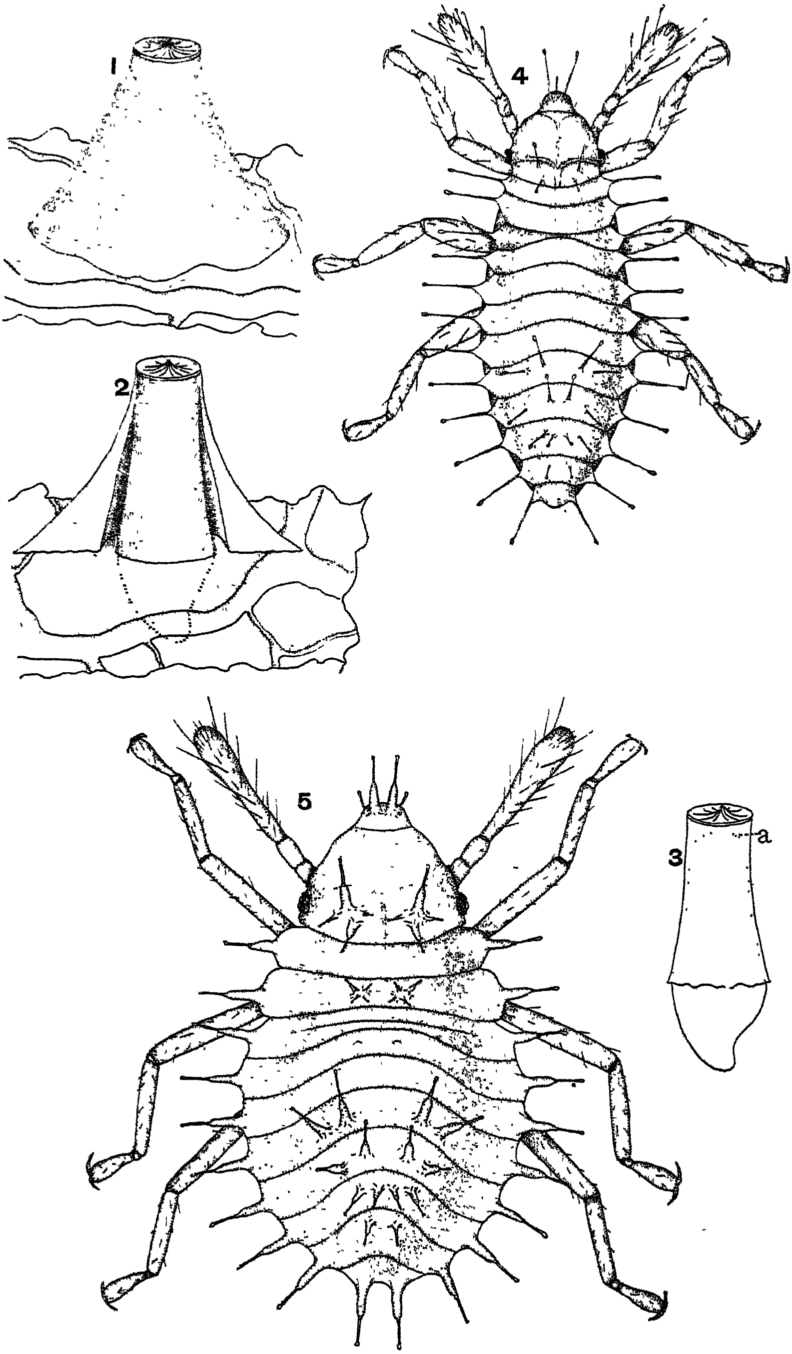


Plate 12. Christmas-berry Tingis

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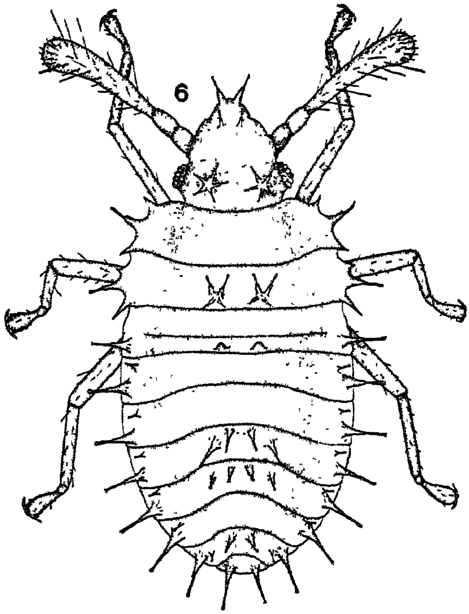

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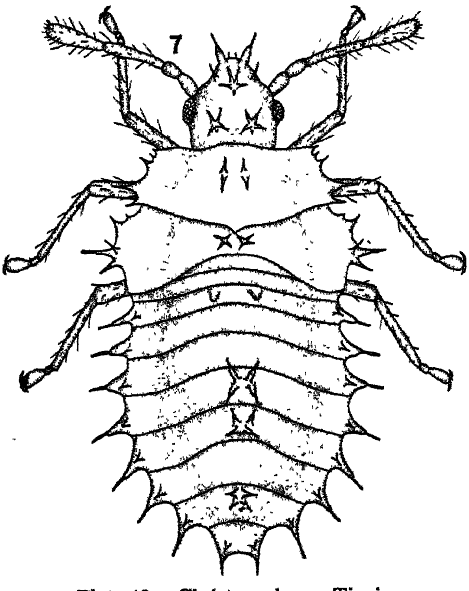

Plate 13. Christmas-berry Tingis

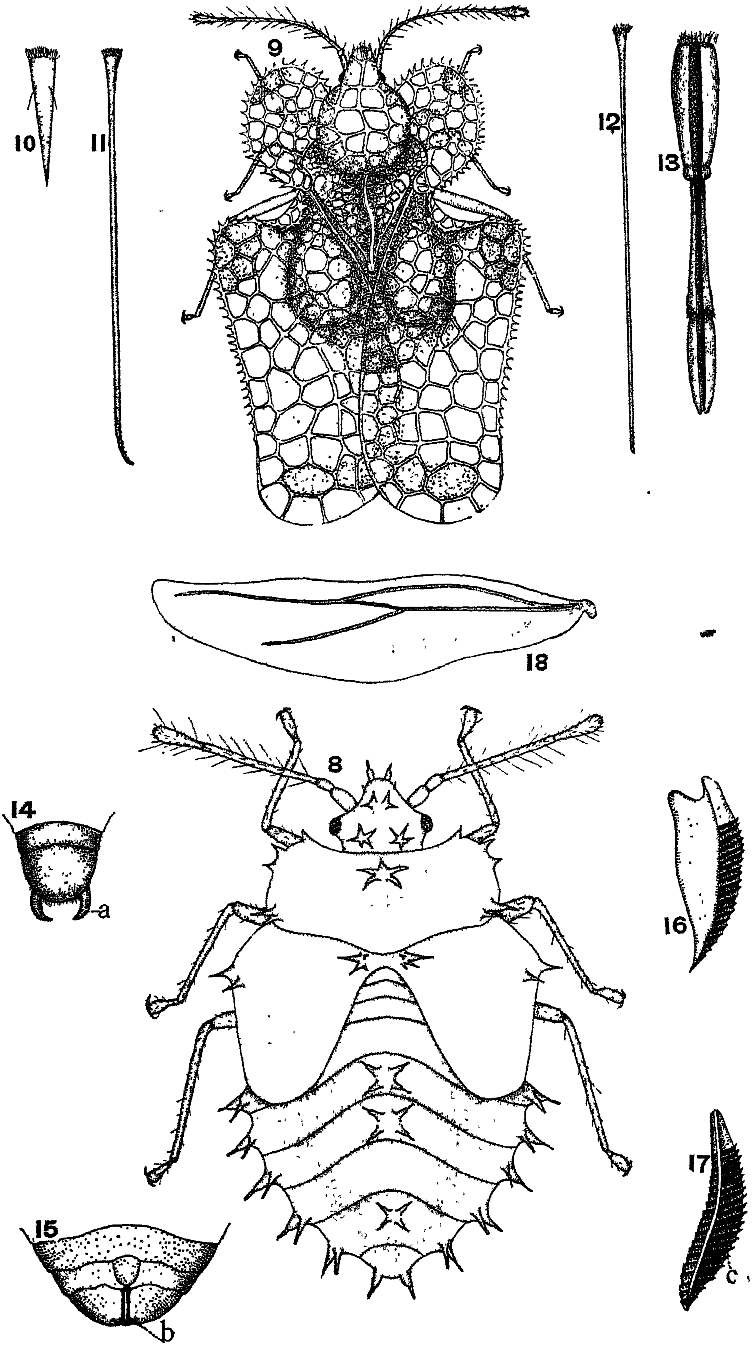

Plate 14. Christmas-berry Tingis

RHOPALOMYIA GROSSULARIÆ n. sp.

By E. P. FELT, *Albany, N. Y.*

The form described below was reared from deformed gooseberry buds, *Ribes grossularia*, in May, 1911, by J. S. Houser of the Ohio Agricultural Experiment Station. The material was collected at Camp Chase. An economic discussion of this species will be given by Mr. Houser. This form, in antennal characters, approaches the North American *Rhopalomyia tridentatæ* Rubs. reared from Artemisia, though it is easily distinguished therefrom by the uniarticulate palpi.

Description: *Male.* Length 1.8 mm. Antennæ extending to the third abdominal segment, rather thickly haired, fuscous yellowish; 16 segments, the fifth having a stem with a length about one half the subcylindric basal enlargement, which latter has a length one half greater than its diameter, a rather scattering subbasal whorl of short setæ and a thick subapical band of longer, curved setæ; terminal segment reduced, narrowly oval. Palpi composed of one short, incrassate segment. Mesonotum shining dark brown, the submedian lines fuscous yellowish. Scutellum yellowish orange, postscutellum and the base of the first abdominal segment shining dark brown. Abdomen sparsely haired, dark reddish brown; genitalia fuscous. Wings hyaline, costa light straw. Halteres fuscous yellowish, somewhat reddish basally. Coxæ reddish brown; femora, tibiæ and tarsi a fuscous straw, the distal tarsal segments somewhat brownish; claws rather long, moderately stout, evenly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment moderately long, broad; terminal clasp segment short, swollen, toothed apically; dorsal plate long, broad, triangularly incised, the lobes irregularly and roundly tapering, rather thickly setose; ventral plate long, moderately broad, deeply and roundly emarginate, the lobes irregularly rounded and sparsely setose. Harpes short, stout, truncate and with sparse subquadrate teeth posteriorly at the internal angle and the external third; style moderately long, stout, subtruncate.

Female. Length 2 mm. Antennæ extending to the third abdominal segment, sparsely haired, reddish brown, the distal segments reddish; 16 segments, the fifth with a short stem, the subcylindric basal enlargement with a length one half greater than its diameter, a moderately thick subbasal whorl of short setæ and a subapical band of longer, slender setæ; terminal segment somewhat reduced, irregular. Palpi composed of one irregular, slightly swollen, thickly setose segment. Mesonotum shining dark brown, the submedian lines sparsely haired. Scutellum a variable fuscous yellowish, postscutellum dark brown. Abdomen deep red; ovipositor fuscous yellowish. Halteres yellowish basally, slightly fuscous apically. Ovipositor when extended with a length about equal to that of the abdomen, the terminal lobes with a length over twice the width, narrowly rounded apically and thickly setose; minor lobes short, setose. Other characters practically as in the male.

Type Cecid a2173, N. Y. State Museum.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

Verify and investigate. Test the old and work out the unknown. This is the keynote to applied entomological activity. The first is hardly less important than the second. There is still too much tradition current as truth, and some of these unproved, though accepted statements, concern matters having a vital relation to control measures. It is a most hopeful sign of the times that so many real contributions to entomological knowledge are appearing. They range from popular bulletins based on recent studies of serious pests to almost entirely original discussions of new forms of injury by obscure species. We now have a series of publications which may well be accepted as standards for similar work with other species or groups. The end of such endeavor is by no means in sight. The studies of recent years have resulted in the accumulation of many facts necessitating a revision of our ideas respecting certain groups and opening up many interesting and also most practical lines of investigation. Some of these studies may not appear to have an immediate practical importance, nevertheless progress along substantial lines depends in large measure upon the continuance of just such apparently theoretical investigations, since a broad knowledge of biology in its various bearings is an essential preliminary to the best practical work.

It is unfortunate that the common name "locust" has been applied to such widely divergent insects as grasshoppers and the periodical cicada. The result is frequently amusing. Some months ago we read an article in a popular magazine discussing the South African grasshopper or locust situation. This notice was illustrated by a series of excellent figures showing the periodical cicada. The latest appears in a fruit paper in which one of our younger entomological friends writes: "It is quite difficult to prevent the locusts or grasshoppers from depositing their eggs in the young shoots of fruit trees

. . . " There is more to the same effect. We presume that the notice was prepared hurriedly. This confusion of ideas could be prevented by adhering and leading the general public to adopt a rational nomenclature for common names. An excellent start has been made and we trust that the effort will be continued till such absurdities are eliminated. Our English brethren recognize the desirability of this, and it is not too much to hope for world-wide coöperation in this respect.

Reviews

The Codling Moth, by L. CAESAR. Ont. Dep't Agric., Ont. Agric. Coll. Bul. 187, p. 1–40. 1911.

An excellent, comprehensive, popular account, based on original observations in Canada and written with special reference to conditions obtained in the Ontario region. There is an admirable series of observations on the transformations of the larva, pupation and appearance of the moths. The discussion of spraying outfits is practical. The author very justly emphasizes the importance of thoroughness in spraying for this insect. While admitting the desirability of throwing the poison into every calyx, we are not quite willing to affirm this as a cardinal necessity, providing the distribution is thorough. We have repeatedly seen spraying where practically every leaf and blossom end was poisoned with very little penetration to the inner calyx cavity and no dripping, yet 95 to 98% of the fruit was free from worms. The record of results following one application is particularly gratifying, the author finding that the sound fruit ranged from 80 to 98% or an average of 90%. There is an excellent series of illustrations. This publication should do much toward making matters plain for the fruit grower.

Fourth Annual Report of the Committee of Control of the South African Central Locust Bureau, CHARLES P. LOUNSBURY, Editor, p. 1–60. 1910.

The record of coöperation in locust control among the South African colonies is continued in this report. One of the most interesting facts is possibly the demonstration that locust eggs, under certain conditions, may retain their vitality for three and one half years. American entomologists confronted by local grasshopper or locust problems will find valuable suggestions in the discussion of poisons. A sweetened preparation of arsenite of soda was largely used for the destruction of these insects, it being either sprayed upon the vegetation or applied as a poisoned bait. This latter should preferably be vegetable matter cut fine and widely distributed, since this procedure greatly lessens the danger of poisoning stock. There have been several cases of the latter in South Africa, all, or nearly all, due to gross carelessness in this respect. The value of this report is greatly enhanced by colored plates illustrating the two important species, and also a series of maps showing the distribution of the insects in both the adult and immature stages.

Tests of Sprays against the European Fruit Lecanium and the European Pear Scale, by P. R. Jones. U. S. Dep't Agric., Bur. Ent. Bul. 80, Prt. 8, p. 149–60. 1910.

This publication is of special value to the economic entomologist, since it gives details of field tests against *Lecanium corni* Bouché and also *Epidiaspis pyricola* Del Guer. The author finds that winter treatments with five or six per cent distillate oil emulsion with and without caustic soda, and a twelve per cent crude oil emulsion are effective in controlling both of these pests without injury. Caustic soda and creosote oil emulsion sprays, while effective in destroying the insects and lichens, are also injurious to the trees. Several excellent illustrations add greatly to the value of this publication.

Medullary Spots: A Contribution to the Life History of Some Cambium Miners, by J. G. Grossenbacher. N. Y. Agric. Exp't Sta. Tech. Bul. 15, p. 49–65. 1910.

This records the discovery of *Opostega nonstrigella* Chamb. as a cambium miner in currants. The study shows this species to be capable of causing direct injury and also, as a result of its operations, facilitating serious fungous infection. The various stages of the insect are described, the original account of the moth reproduced and our knowledge of European species summarized. There is an excellent series of illustrations. The author is to be congratulated on having discovered the larva in this country.

The Smoky Crane-Fly, by James A. Hyslop. U. S. Dep't Agric., Bur. Ent. Bul. 85, Prt. 7, p. 119–32. 1910.

This paper records serious injury to Japanese clover, *Lespedeza striata*, in Tennessee by the smoky crane-fly, *Tipula infuscata* Loew. The life history and habits of this species are carefully worked out and a summary given of the more important records of injury by Tipulid larvæ. There is also a list of birds, compiled from the records of the Bureau of Biological Survey, known to feed to a greater or lesser extent upon the Tipulidæ or their eggs. This bulletin, with its admirable series of illustrations, forms an excellent basis for further studies in this group.

The Control of the Argentine Ant, by C. W. Woodworth. Cal. Agric. Exp't. Sta. Bul. 207, p. 53–82. 1910.

This is a well illustrated bulletin discussing the Argentine ant and other Formicidæ. It is somewhat technical in that it gives keys to subfamilies and genera and lists the species found in California. The admirable series of illustrations and the keys will be very helpful to students of the California fauna. The author states that there are in California about forty colonies of the Argentine ant distributed over some 5,000 acres. Under control measures he gives prominence to the excluding of the pests and ant-proof construction. The use of carbon bisulfid, a solution of potassium cyanide or a sweetened arsenical preparation is advised for the destruction of these pests.

Some Common Bag Worms and Basket Worms, by Claude Fuller. Natal Dep't of Agric., Bul. 16, p. 1–11. 1909.

The natal bag worm fauna, judging from the acocunts, is a most interesting one. This publication is a popular discussion of Psychidæ larvæ with observations. upon a number of species. Unfortunately, the latter are designated only by common names. The excellent illustrations add greatly to the value of this contribution to entomological knowledge.

Current Notes

Conducted by the Associate Editor

The Peruvian government has extended the contract of Mr. C. H. T. Townsend, as Entomologist of State, to December 31, 1912, at a substantial increase of salary. Mr. Townsend expects to conduct extended work with parasites and predaceans during the next two years against the white scale of cotton (*Hemichionaspis minor*), the cotton-square weevil (*Anthonomus vestitus* or n. sp.), and several other important cotton insects in Peru. Measures are under way to establish a cotton insect laboratory at Piura, with an area of growing cotton for experimental purposes attached, and to secure a trained assistant from North America who can qualify for research work on pests and parasites. Mr. Townsend's address will continue to be Piura (Piura), Peru, South America.

Mr. John J. Davis has resigned his position with Prof. S. A. Forbes, state entomologist of Illinois, and is now connected with the Bureau of Entomology. His work is especially on *Lachnosterna* and *Aphididæ*, under Prof. F. M. Webster, and his headquarters for the present will be at the Agricultural Experiment Station, Lafayette, Ind.

Mr. D. K. McMillan of the Bureau of Entomology, who has been stationed at Brownsville, Texas, and engaged in truck crop investigations, has resigned to accept a position with Prof. S. A. Forbes in similar work in Illinois. His entomological friends and associates gave him a farewell dinner on March 8, according to *Entomological News*.

Fred E. Brooks has resigned as associate entomologist of the West Virginia Agricultural Experiment Station to take up work with the Bureau of Entomology. Mr. Brooks will have charge of investigations of certain fruit insects throughout the Appalachian region under the direction of Professor Quaintance. His field station will be at French Creek, W. Va.

Mr. Walter S. Abbott, assistant in entomology at the New Jersey Agricultural Experiment Station, resigned March 1 to accept an appointment as assistant in charge of collections, records and insectary at the Agricultural Experiment Station of Illinois at Urbana, under Prof. S. A. Forbes.

Prof. William B. Alwood, formerly state entomologist of Virginia, now of the Bureau of Chemistry, sailed April 13 for Gibraltar. He will investigate the viticultural conditions of Southern Europe and attend the International Agricultural Congress at Madrid.

At the University of California, work has commenced on the new agricultural building, which will be constructed of white granite and will be 162 by 64 feet in size. The entomological department will have quarters on the second floor of this building.

The Alabama legislature has just appropriated to the Experiment Station $26,800 annually, of which $2,300 is for combatting the cotton boll weevil and other injurious insects.

William H. Dean, Jr., formerly of the Bureau of Entomology, has been appointed assistant entomologist of the Texas Agricultural Experiment Station.

Mr. E. E. Scholl has resigned as instructor in entomology at the Agricultural and Mechanical College, College Station, Texas.

Mr. R. E. Snodgrass has resigned his position with the Bureau of Entomology.

Dr. Samuel H. Scudder of Cambridge, Mass., the veteran author of the monumental three-volume work on the Butterflies of the Eastern United States and Canada, and well known for his classic works on the Orthoptera and fossil insects, died May 17, at the age of seventy-four years.

Col. William Gorgas of the United States Army, who has had charge of several sanitary crusades, especially in doing away with mosquito breeding places in localities where yellow fever is prevalent, was honored by Tulane University with the degree of Doctor of Laws.

It is gratifying to note that George Washington University has conferred the honorary degree of M. D. upon the highly esteemed chief of the United States Bureau of Entomology, Dr. L. O. Howard. This is not only a recognition of the abilities of the man, but is striking testimony to the standing economic entomology is beginning to hold in the estimation of the medical profession.

We learn through the *College Signal* of the Massachusetts Agricultural College, that A. H. Kirkland, well known to entomologists because of the prominent part he took in gipsy and brown-tail moth work in Massachusetts, is now in Utah for special service in connection with the United States Bureau of Entomology investigation of the alfalfa weevil.

A notice just at hand states that Charles P. Lounsbury, entomologist, Cape Town, Cape of Good Hope, South Africa, has become chief of the Division of Entomology, Union Department of Agriculture, Pretoria, South Africa. We trust that this means promotion and an enlarged field for one who has made an enviable record in a country distant from entomological centers.

We learn through Dr. L. O. Howard, chief of the Bureau of Entomology, United States Department of Agriculture, that Mr. D. Van Hove has been appointed entomologist for Belgium, the information being transmitted by the American consul at Ghent, through the Secretary of State and Secretary of Agriculture.

The Minnesota State Legislature, at its last session, appropriated six thousand dollars for two years' work against grasshoppers under the direction of the State Entomologist. Grasshoppers were injurious in 1909 and 1910, destroying at least two thirds of the flax crop of the state. Three or four men are already in the field at different points of the Red River valley, aiming to discover some method or methods by which the individual farmer can protect his crops from these insects.

Mailed June 22, 1911.

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FIELD WORK IN THE CONTROL OF THE ARGENTINE ANT

By L. J. Nickels

In Berkeley at the present time we have two small, isolated colonies of Argentine ants (*Iridomyrmex humilis* Mayr). One colony covering originally about four blocks is situated in the southern portion of the city near Ashby Station; the other covering originally parts of two blocks is located a short distance from the University Campus.

These colonies have been known for at least two years; no attempt at control was made, however, other than that of the householders, which due to their lack of coöperation, proved unavailing.

The southern territory is covered for the most part with one-story frame dwellings. The one nearest the University is more diversified, one fifth of the area supports brick and stucco buildings, ranging from two to four stories in height, the remainder is covered by frame buildings two to three stories high, also two vacant lots, the larger of these about 150 ft. square has not been infested although ants were numerous in three sides of it.

The situation under observation represents extremely favorable conditions for the ant. The residents are not particularly careful in the disposal of their garbage and a bakery, butcher shop, and a hotel furnish a great abundance and never-ending supply of meat scraps and sweets.

Early in the fall of 1910 Professor Woodworth of this station (University of California Agricultural College, Department of Entomology) published Bulletin No. 207, "The Control of the Argentine Ant" in which the plan was suggested for controlling the insect,—the Argentine or other species, as the result of detailed studies, of using a weak arsenical poison.

About this time the residents of both districts appealed to the University and also the city authorities for help in controlling the pest which was not only proving a great annoyance but depreciating property values.

The work was started with an appropriation of five hundred dollars by the municipality.

In the description of the actual field work I shall limit myself to the minor territory, which I personally handled.

As in any control work, such as this, the extent of the district affected must first be determined. To do this a canvass was made from house to house, one block in all directions beyond the known limits of the foragers. In order to keep an accurate record, cards three inches by four inches were used, one for each city lot, one side being occupied by the street on which the house is situated with the number, also a plan of the lot, including the position of the house on the premises, considering the outer edge as the boundary. Ant nests, trails, trees, shrubs and bushes were indicated by suitable symbols. The reverse side was used for notes and a record of the treatment, each jar being allotted a number. The cards for each block were placed in a small paper folder to facilitate the handling as a unit.

The result of the preliminary examination showed the ants extremely abundant. Three fourths of the block were occupied by *Iridomyrmex humilis*, the remainder by *Prenolepsis imparis* Say.,—the honey ant.

Practically every square yard of ground was visited by scouts or covered by trails. This was due in part to the fact that many small nests existed and secondly, since many of the houses are flats, there were at least four regular sources of food; in most cases carelessness with garbage furnished an intermittent source and this, together with a large number of scale-bearing trees, furnished ample subsistence for prosperity and rapid increase. Notwithstanding the presence of supplies upon the ground, the ants visited the upper stories of all the buildings. Trays brought to rooms on the fourth story of the hotel within a very short time would be literally covered with ants. On each floor refuse barrels were situated, which were visited constantly; the scraps about these gave sufficient incentive for the ants to come in a small but endless stream and so be on the lookout for all possible sources of food.

The baker, due to the invasion, at one time found it necessary to suspend business for a short period. The butcher found it exceedingly difficult to keep ants from his ice chest and the like.

Conversation with the residents brought out the fact that they had spent a good deal of time and money in driving the ants away only to bring on fresh visits. The ground in this locality is adobe,

the summer cracks offer a multitude of excellent nesting places, many stone sidewalks make disturbance of the colonies underneath impossible, so that on the whole the block is very favorable for the success of ants, and being successful proved amply that the average battle against the ant is fought upon the wrong end of the invasion.

For those who are not familiar with the control measures suggested in Bulletin 207, I will outline them briefly. A sponge moistened with sugar syrup containing 1-4 to 1-8 per cent sodium arsenite ($Na\ As\ O_2$) is placed in a suitable container with a perforated cover. The ants visit this receptacle and carry the syrup to the nest where it is fed to the brood and to the queen, slowly poisoning them, shutting off the increase of the colony which ultimately means utter extinction.

The next step after examining the territory was to prepare the poison. Pint screw-top jars have been found the best, easiest to handle and least liable to injury by exposure, of the more easily obtainable receptacles. The tops are prepared by breaking out the porcelain cap and making four holes with any suitable implement. A twenty-penny nail with its point filed flat and a round block made a very good punching outfit. One should expect to prepare about 100 jars an hour by this method. In all we are using about 350 jars, 300 furnished by the city and the remainder from the University stock (about 150 are being used in the block under discussion).

During this operation the first lot of poisoned syrup was prepared, using 20 pounds of sugar,—6 to 7 pounds of water and a fraction over an ounce of the arsenic, this being 1-4 per cent of the total weight. Sodium arsenite contains about 57½ per cent of arsenic so that the above quantity falls within the established limit. It was found necessary to heat the syrup mixture for about three hours in a water bath. The arsenite should first be dissolved in hot water before it is added to the sugar solution. In places where cheap molasses can be obtained, this could doubtless be used. On the Pacific Coast granulated sugar will give the cheapest syrup. About ten pounds of the liquid syrup to every one hundred jars is necessary for the first charging.

Ten pounds of sponges cut to about one half the size of the interior of the jar will give a sufficient number for 300. In manipulating the sponges it is best to sharpen the cutting knife after every slice and have them moist. This aids cutting and in the absorption of the sugar solution. The jars can be most quickly charged by first inserting the sponge and then pouring on about one half a gill of the liquid.

In beginning the actual poison work it was thought best to start on the most difficult situations. In the light of this the hotel was chosen as the starting point, 50 jars were distributed, mainly about

the kitchen and dining room. About half of these were visited intermittently, only three of the number were visited constantly. Within ten weeks from the start, the last of the ants disappeared from the hotel, and, to the great satisfaction of all concerned, have not returned. This is rather remarkable in that only about 1-4 pound of syrup was actually consumed. The expense was not over $25.00. Considering the fact that many patrons had left the hostelry because of the ants insisting upon dining with them and occasionally evading the cook and combining with the meal,—$25.00 is a small expenditure and the results extremely worth while.

As the work progressed, when it was established that jars were not being visited, they were moved to new locations. Towards the end of a campaign, the ants appear to be very migratory, appearing first here and then perhaps a hundred yards away.

For the ordinary city lot 8 to 12 jars are necessary. Rarely are they all visited at one time, as a rule only one or two are drawn upon constantly. The results, however, seem to indicate that it is only necessary for a small percentage of the foragers to invade a jar in order to insure the destruction of a colony.

The lots in the block under consideration are large. Twenty-three of these lots were infested and in every case ants are very much more scarce than formerly and in only about one fourth of them are any ants now present. When the work started at least 20 pantries were being constantly visited; since the beginning of the year we have only one record, this was the last house to be provided with jars and also the last to receive a spring re-charging.

In handling the jars the present experience suggests that

1. Better results might be obtained outside by shifting the jars a yard or so about every two weeks;

2. Jars inside a house do not need to have their locations changed frequently;

3. In damp situations or in rainy weather the jars had best be on their sides, first to exclude moulds and, secondly, to keep out rain water.

4. During the rainy season which probably compares with a very humid climate a sponge will stay moist for at least three months;

5. In dry weather moistening the sponge with a little water will keep them serviceable indefinitely;

6. An ordinary trail of ants will not exhaust a jar for a month or six weeks;

7. In no case have ants survived where a constantly visited jar has been twice emptied by the ants.

8. Where food is particularly abundant it may be advantageous to

supply the jars with a little extra bait, maple syrup or honey, and nests occurring in concrete sidewalks or in foundations can be stopped off by filling the cracks or entrance with a little plaster of paris. This has proved very effective.

I will give you the costs of the undertaking so far, which we estimate to be about four times as much as it will be in future work, due to the fact that since this was the first time systematic ant extermination has ever been attempted, it was thought wise to give the jars much more attention than will be necessary in future work.

Supplies for five blocks........................	$53.61
Labor at 40 cents per hour for the large territory and 50 cents an hour for the small amounted to	199.75
Total	$253.36

for six months work.

Now we will attempt to estimate what a square mile of control work will cost. In the average San Francisco section there are eight blocks to one side of the square and 17 to the other, in all giving 136 blocks and 50 miles of streets. If it were necessary to go from house to house and enter each yard from the street in order to make a circuit of the jars one would have to travel about 150 miles. A man can cover ten miles of street in this way a day. Two men could cover the territory once a week and $2,400.00 should furnish ample salary. So far we have expended about $10.00 a block for supplies. To insure safety one might consider $15.00 a square a safer estimate for the large territory, this gives $2,040.00 for supplies, totaling $4,440.00. About $500.00 should be added to this to pay the hire of an extra man occasionally and to insure against inefficiency, possible breakage, etc.

From this it will be seen that $5,000.00 will pay for a year's campaign per square mile of territory. This gives $37.40 as the cost for one block. Most squares have fifty subdivisions, this means about 75 cents per lot per year for poisoning and ultimate extermination. In case it be necessary to continue the work for more than one year it seems probable that another $1,000.00 should be enough to finish the work the second year.

For a large area like that in Oakland, Alameda, San José or Los Angeles the jars could be shifted on to new territory as fast as the old is cleaned up. Allowing a large margin of safety, subsequent sections of land should be taken care of for $3,000.00 or 45 cents to the lot per year.

In the small area in which the work is being done, the average expenditure by the residents was at least $25.00 in time and money per month

at the time the University took up the work. This shows the astonishing fact that the people were spending enough money on one block to practically exterminate the ants in nine when done in a systematic manner. And yet the ants were constantly spreading notwithstanding their efforts.

As I have said, the results so far are very satisfactory. We have established that it is possible to exterminate the Argentine ant and to absolutely prevent its spread.

LEGISLATION IN CANADA IN REFERENCE TO INJURIOUS INSECTS AND PLANT DISEASES

By C. Gordon Hewitt, D. Sc., *Dominion Entomologist, Ottawa*

The Department of Agriculture of Canada is empowered by the Destructive Insect and Pest Act of 1910 to take such action as may be deemed necessary to prevent the introduction or spreading of injurious insects, pests and plant diseases. All plants, with the exception of certain classes such as greenhouse-grown plants, herbaceous perennials, bulbs, etc., may be imported at certain seasons of the year only and through certain ports as specified in the Regulations. The Department of Agriculture has power to inspect plants liable to be infested with certain insects and plant diseases, to destroy the same if necessary or to prohibit their importation into Canada.

At six of the ports of entry (See Section 3 of the Regulations) fumigation stations are established where plants from countries and states infested or liable to be infested with the San José scale are fumigated with hydrocyanic acid gas by special officers in charge.

Plants from Europe, Japan and the states of Vermont, Maine, Massachusetts, New Hampshire, Connecticut and Rhode Island, six of the United States of America, are inspected by officers of the Department for the brown-tail moth and gypsy moth. In some cases this inspection is made at the port of entry, in other cases at the destination of the stock. In the latter case the plants may not be unpacked except in the presence of an inspector.

It is necessary for all persons and transportation companies importing or bringing plants into Canada to notify the Dominion Entomologist, Ottawa, of the fact, and through the coöperation of the Department of Customs, the custom officers at the ports of entry also send advices of the arrival of shipments of plants at the various ports through which plants may enter.

In addition to the inspection and fumigation of imported plants, a number of field officers are employed in inspecting orchards and in

carrying out eradicative measures against the brown-tail moth in those regions in Nova Scotia and New Brunswick infested with the insect. This eradicative work is carried out in coöperation with the respective Provincial Governments. The fumigation and inspection of imported plants and of infested regions and eradicative work is carried on under the direction of the Dominion Entomologist.

The Minister of Agriculture has power to prohibit the importation of plants from any given region should it be deemed necessary, owing to the presence of serious insect pests or diseases in such a region. This has been done in the case of potatoes from Newfoundland and the neighboring islands to prevent the introduction of potato canker (*Chrysophlyctis endobiotica*).

The Destructive Insect and Pest Act and the Regulations issued thereunder are appended.

In addition to the legislation of the Federal Government, certain of the Provincial Governments have instituted legislative measures in reference to plant diseases and pests.

The Province of British Columbia inspects all plants and fruit entering the province, and any plants or fruit found to be infested with insect pests is either treated or condemned.

The Province of Ontario has legislation chiefly referring to the inspection of nurseries and the treatment of plants grown in nurseries.

The Province of Nova Scotia has recently enacted legislation under which the Department of Agriculture for the province will have power to inspect orchards and take such steps as are necessary for the eradication or control of the more serious insect pests and plant diseases.

THE DESTRUCTIVE INSECT AND PEST ACT

An Act to Prevent the Introduction or Spreading of Insects, Pests and Diseases Destructive to Vegetation

(9–10 Edward VII, Chap. 31. Assented to 4th May, 1910.)

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:

1. This Act may be cited as "*The Destructive Insect and Pest Act.*"

2. In this Act, unless the context otherwise requires, "the Minister" means "the Minister of Agriculture."

3. The Governor in Council may make such regulations as are deemed expedient to prevent the introduction or admission into Canada, or the spreading therein, of any insect, pest or disease destructive to vegetation.

4. Such regulations may provide:

(a) for the prohibition generally, or from any particular country or place, of the introduction or admission into Canada of any vegetable or other matter likely to introduce any such insect, pest or disease;

(b) the terms or conditions upon, and the places at which any such vegetable or other matter may be introduced or admitted into Canada;

(c) for the treatment and manner of treatment to be given to any vegetation, vegetable matter or premises in order to prevent the spreading of any such insect, pest or disease, and may prescribe whether such treatment shall be given by the owner or by a person appointed for such purpose;

(d) for the destruction of any crop, tree, bush or other vegetation or vegetable matter or containers thereof infested or suspected to be infested with any such insect, pest or disease;

(e) for the granting of compensation for any such crop, tree, bush or other vegetation or containers thereof so destroyed, such compensation not to exceed two thirds of the value of the matter destroyed and to be granted only by the Governor in Council upon the recommendation of the Minister;

(f) for the prohibition of the sale of any vegetable matter infected with any such insect, pest or disease;

(g) that the occupier of the premises on which is discovered any such insect, pest or disease shall forthwith notify the Minister and shall also send specimens of such insect, pest or disease;

(h) for the confiscation of any vegetable matter and the container thereof, if any, in respect of which a breach of this Act, or any regulation made thereunder is committed and generally for any other purpose which may be deemed expedient for carrying out this Act, whether such other regulations are of the kind enumerated in this section or not.

5. The Minister may appoint inspectors and other officers for carrying out this Act and the Regulations made thereunder.

2. Such appointments, if not confirmed by the Governor in Council within thirty days of the date thereof, shall lapse and cease to be valid.

6. Any inspector or other officer so appointed may enter any place or premises in which he has reason to believe there exists any such insect, pest or disease; and may take specimens thereof and also of any vegetable matter infested or suspected of being infested therewith.

7. The Minister, upon the report of any inspector setting forth a reasonable belief of the existence of any such insect, pest or disease in any area defined in such report, may prohibit the removal from such area or the movement therein of any vegetation, vegetable or other matter which, in his opinion, is likely to result in the spread of such insect, pest or disease.

8. Every person who contravenes any provision of this Act, or any regulation made thereunder, shall be liable, upon summary conviction, to a fine not exceeding one hundred dollars, or to imprisonment for a term not exceeding six months, or to both fine and imprisonment. Any vegetable or other matter imported or brought into Canada contrary to this Act, or to any regulation made thereunder, shall be forfeited to the Crown.

9. Every order in council and regulation made under this Act shall be published in *The Canada Gazette*, and shall be laid, by the Minister, before Parliament within fifteen days after the commencement of the then next session.

10. The *"San José Scale Act"* is repealed.

Regulations

issued under the Destructive Insect and Pest Act,
(by order in Council of 27th February, 1911.)

1. "Inspector" means a person appointed for carrying out the provisions of the Destructive Insect and Pest Act and the regulations made thereunder.

2. No tree, plant or other vegetation or vegetable matter infested with any of the

insects, pests or diseases, to which this Act applies, shall be imported into Canada except as hereinafter provided.

3. Nursery stock, including all trees, shrubs, plants, vines, grafts, scions, cuttings or buds which are not hereinafter exempted, entering Canada shall be imported only through the ports and during the periods respectively hereinafter mentioned, that is to say:

Vancouver, B. C., from October 1 to May 1.

Niagara Falls, Ont., from October 1 to May 15.

Winnipeg, Man., and St. John, N. B., from March 15 to May 15, and from October 7 to December 7.

Windsor, Ont., and St. Johns, P. Q., from March 15 to May 15, and from September 26 to December 7.

At these points of entry the importations shall be fumigated in the fumigation houses provided for that purpose, and a certificate of fumigation will be issued, without which no stock may be taken out of bond.

Importations by mail shall be subject to the same regulations.

All nursery stock originating in Japan or in any one of the states of Vermont, New Hampshire, Maine, Massachusetts, Connecticut and Rhode Island, six of the United States of America, shall, after fumigation, be subject to inspection as provided by Section 6 of these Regulations.

Provided, however, that the following vegetation and florist's stock shall be exempt from fumigation and may be imported at any season of the year and through any port without inspection:

(*a*) Greenhouse-grown plants, including roses in foliage which have been grown in pots up to three inches in diameter but not larger. A certificate that the plants have been grown under glass must accompany the invoice and shall be signed by the consignor.

(*b*) Herbaceous perennials (the stems of which die down in winter), such as perennial phlox, peonies, sunflowers, etc.

(*c*) Herbaceous bedding plants (such as geraniums, verbenas, pansies, etc.)

(*d*) Bulbs and tubers (such as hyacinths, lilies, narcissi and other true bulbs and also the tubers of dahlias, irises, etc.)

(*e*) Cottonwood or Necklace Poplar (*Populus deltoides*) when shipped from and grown in Dakota or Minnesota, two of the United States of America.

4. The port by which it is intended that the nursery stock shall enter shall be clearly stated on each package and all shipments made in accordance with these regulations will be entirely at the risk of the shippers or consignees, the Government assuming no responsibility whatever.

5. All persons importing nursery stock, except such as is exempt from fumigation or inspection under Section 3 of these Regulations, shall give notice to the Dominion Entomologist, Experimental Farm, Ottawa, within five days of dispatching the order for the same, and they shall again notify the Dominion Entomologist on the arrival of the shipment in Canada.

Notice shall also be given to the Dominion Entomologist by all transportation companies, Custom House Brokers or other persons importing or bringing into Canada nursery stock that is subject to inspection as hereinafter provided, immediately such a consignment is received by them. Such notice shall include the name of the consignor and the consignee, the points of origin and destination, the name of the company carrying the nursery stock, as well as the nature, quantity and origin of the same.

6. Nursery stock, not including such stock as is exempt under Section 3 of these Regulations, originating in Europe, shall be imported only through the ports and

during the periods specified under Section 3 for stock requiring fumigation, with the addition of the ports of Halifax, N. S., Sherbrooke, P. Q., and Montreal, P. Q., through which ports such European stock may enter from September 15 to May 15. Such European nursery stock, and such other imported vegetation, as the Minister may determine, entering Canada, shall be exempt from fumigation, but shall be inspected either at the port of entry or at its destination to which it may be allowed to proceed, but in the latter case it must not be unpacked except in the presence of an inspector.

7. If, on inspection, nursery stock or other vegetation or vegetable matter is found to be infested with any of the insects, pests or diseases hereinafter specified, it shall be destroyed to the extent deemed necessary by the inspector and in his presence. All cases, packages and packing in which such stock has been contained shall also be destroyed in the same manner.

8. Any inspector entering any lands, nursery or other premises where there is reason to believe that any of the insects, pests or diseases hereinafter specified are or may be present, shall give instructions for the treatment or destruction of any tree, bush, crop or other vegetation or vegetable matter or the containers thereof, which may be found or suspected to be infested with any of the insects, pests or diseases hereinafter specified, and such instructions shall be carried out by the owner or the lessee of the infected or suspected vegetation, vegetable matter or containers thereof, and such remedial treatment shall be carried out and continued until the insect, pest or disease shall be deemed by the Inspector to have been exterminated.

9. Compensation not exceeding two thirds of the value as assessed by the Inspector, of the vegetation or vegetable matter or containers thereof destroyed by the instructions of an Inspector, shall be granted by the Governor in Council upon the recommendation of the Minister.

10. It shall be illegal to sell, offer for sale or in any way dispose of or receive any trees, shrubs, or other plants, vegetable matter or portions of the same, if the same are infested with any of the insects, pests or diseases hereinafter specified.

11. The owner, occupier or lessee of any premises or place where any of the insects, pests or diseases specified herein shall be found, shall immediately notify the Minister and shall also send to him specimens of such insects, pests or diseases.

12. The destructive insects, pests and diseases to which the said Act shall apply shall include the following:

The San José Scale (*Aspidiotus perniciosus*).
The Brown-tail Moth (*Euproctis chrysorrhœa*).
The Woolly Aphis (*Schizoneura lanigera*).
The West Indian Peach Scale (*Aulacaspis pentagona*).
The Gypsy Moth (*Porthetria dispar*).
Potato Canker (*Chrysophlyctis endobiotica*).
Parasitic diseases affecting potatoes externally or internally.
Branch or Stem Canker (*Nectria ditissima*).
Gooseberry Mildew (*Sphærotheca mors-uvæ*).
White Pine Blister Rust (*Peridermium strobi*).

13. The importation of potatoes into Canada from Newfoundland or the Islands of St. Pierre or Miquelon is prohibited.

14. The Minister may, upon special request to that effect, authorize the importation into Canada of any insect, pest or disease hereinafter specified, but for scientific purposes only.

15. The Regulations made under the "San José Scale Act" are repealed.

ORGANIZED EFFORTS AS A FACTOR IN THE CONTROL OF THE CITRUS WHITEFLY

By A. W. Morrill, *Phœnix, Arizona*

The problem of the control of the citrus whitefly has long been generally recognized as more difficult than that offered by any other citrus pest now established in the United States. This rating, which has very properly been given, is due to the power of flight possessed by both sexes of the adult insects combined with most of the worst characteristics as to habits, rate of multiplication and destructiveness possessed by true scale insect pests.

An important feature of the problem of whitefly control by means of the methods at present available for general use—spraying and fumigation—is that of extending the availability of these methods by securing the necessary coördination of efforts among the owners of neighboring citrus groves. Recent experimental work has resulted in bringing the direct remedies mentioned within the reach of the owners of isolated groves and of citrus growers in all localities where coöperative associations have been organized for combating the whitefly. While it is true that the pest may be controlled by the intelligent and persistent use of direct remedies under less favorable conditions than these, there remains the problem of securing the best practicable condition of control upon the most profitable basis. The writer is confident that any such a condition or anything approaching it can be brought about only through proper legislative enactments. Such action on the part of the state legislatures may be effectively supplemented by coöperative protective associations among the citrus growers and also by fruit marketing organizations. It is the object of this paper to present the ideas of the writer concerning these subjects, which ideas have been derived from a general knowledge of citrus conditions in the Gulf Coast States and more particularly from three years' connection with the whitefly investigations of the United States Department of Agriculture in Florida.

Losses from the Whitefly and Estimated Expense of Competent Supervisory Organizations

The citrus whitefly (*Aleyrodes citri* R. and H.) and the cloudy winged whitefly (*Aleyrodes nubifera* Berger) cause annual losses in Florida, Louisiana and Texas amounting to at least one and one-half

million dollars per year.[1] In two counties in Florida (Manatee and Orange) the losses from whiteflies amount to fully two hundred thousand dollars each per year and in several others it amounts to more than one hundred thousand dollars per year. With losses such as these, usually representing in infested groves between one third and one half the value of a crop, practically all business interests in important citrus fruit producing localities are vitally concerned. Bankers and merchants for example, even though not owners of citrus groves, are in many localities in Florida fully as much dependent in a business way on the citrus fruit crops as is the average grower. It is a noteworthy fact, moreover, that in many important business centers in Florida, such as Orlando, Bartow and Fort Myers a large percentage of the bankers, merchants and professional men are grove owners or part owners and are consequently doubly interested in the success of the citrus industry.

The first point for consideration in connection with suitable legislative enactments is the extent to which expenditures by state or county are justified. According to the estimates of the writer, the expense of a suitable supervisory organization would be insignificant beside the direct benefits that would result and moreover would be fully compensated for by the incidental reduction in the amount of injury by scale insects.[2] An amount between five and ten per cent of the total losses resulting from whitefly attack on the basis of a forty per cent damage in each infested grove should be ample to cover such expense. In countries or localities where the whiteflies do not exist or where they infest only a small percentage of the citrus groves, not more than one per cent of the gross value of the citrus crop should be necessary for checking the spread of the insects in order to delay to the utmost the time when the infestation in the county or locality will be general. These estimates of the amount, which will be needed for the carrying out of a program of whitefly control supported by legislative enactment, indicate in a general way the necessary expense for different sections. In Florida, the leading citrus fruit growing counties such as Orange, De Soto, Manatee and Polk, would require in the writer's opinion from eight to ten thousand dollars annually for the support of efficient county organizations created in accordance with the provisions of a state law. Other counties in which citrus growing interests are less important would require smaller organi-

[1]The writer estimates that more than four fifths of this loss is caused by the citrus whitefly and less than one fifth by the cloudy winged whitefly. The discussions which follow apply to both species except as affected by the latter species being confined to citrus as a food plant.

[2]Bul. 76, Bur. Ent., U. S. Dept. Agric., p. 60–62.

zations and proportionately smaller expenditures and the work of combating whiteflies in some cases could be conducted to best advantage by means of one organization supported jointly by two or more adjoining counties.

Organization of Officials for Efficient Service

In Florida the office of State Horticultural Commissioner would be practically superfluous as regards whitefly control. Rather than create such an office, the writer would strongly recommend that offices already existent in connection with the State Experiment Station be given additional support. It would be especially undesirable and a serious impediment to progress in whitefly control for an organization to be provided for, which would place a State Horticultural Commissioner or other official in charge of all the work of the state. For effective results the officials in charge must have an opportunity to come in close contact with actual field conditions having supervision over the work in limited territories—only a single county in many instances. They must be competent as to entomological matters, of good executive ability, and must be able to command the respect and confidence of the citrus growers. Such men must be as able men in their line as it is possible to procure and should not be subject to the direction of an official superior.

An assistant to the official in charge, capable of acting in charge of all work temporarily as the occasion may demand, one or two inspectors and an office assistant are needed to complete the organization in a leading citrus growing county. The attempt to accomplish satisfactory results in combating the whiteflies in Florida in such counties as Orange, Lake, Polk, Lee, De Soto, Manatee and Hillsboro with a smaller organization than that mentioned would be a serious mistake, at least until such time as a satisfactory condition of control is brought about and experience shows the practicability of reducing expenses in this manner.

The organization of the various county entomologists into a State Crop Pest Commission as hereafter outlined is advisable in order to give each local official status as a state officer for legal reasons, in order to establish state quarantines when necessary and also to secure as far as practicable uniformity of methods in administering the State Horticultural Law in the different counties.

State Laws

The states of Louisiana and Texas already have horticultural laws which, with proper financial support, might be administered to good effect in the control of whiteflies. Dealing with trees which average

much smaller in size, the control of whiteflies by spraying and fumigation in these states as compared with Florida is not a difficult matter. Certain modifications of these existing laws are desirable, however, while in Florida an existing law which authorizes the appointment of county boards of horticulture and which is now ineffective through disuse and inadequacy should be entirely repealed to prevent future confusion. In its place a carefully drawn law is needed, especially adapted to meet local conditions and embodying such features as investigations of the whiteflies have shown to be advisable.

In accordance with the views of the writer the following are essential features of such a law:[1]

1. The County Commissioners or Supervisors of any county should be authorized to appoint a County Entomologist upon receiving a petition to do so from at least twenty-five fruit growers, provided that when the horticultural interests in two or more adjoining counties are comparatively small a single official may be appointed jointly by the commissioners of the several counties upon petition from twenty-five fruit growers in each county concerned.

2. It should be required that these appointments be made from an approved list of available economic entomologists maintained by a state committee on credentials consisting of the governor of the state, the president of the State Horticultural Society and the director of the State Agricultural Experiment Station.

3. The various county entomologists appointed as above should be constituted into a State Crop Pest Commission.

4. The Entomologist of the State Agricultural Experiment Station should be designated the State Entomologist.

5. County entomologists should be appointed for a specified period, not less than two years nor more than four years being advisable. Dismissal by the county commissioners at any time should be authorized in the case of inefficiency or neglect of duty, but only with the approval of the State Committee on Credentials following a hearing by that committee.

6. Each County Entomologist should be authorized to appoint such assistants as may be necessary with the approval of the County Commissioners. Regularly appointed assistants or inspectors should be granted all of the authority given to the County Entomologist when

[1]Anyone interested in the constitutionality of any of the features herein recommended if enacted in a state law should consult the court decisions in California cases. The definitions of nuisances in these cases are especially valuable. These decisions are published by the state of California in a pamphlet entitled "California's Horticultural Statutes with Court Decisions and Legal Opinions Relating Thereto (Sacramento 1908)."

working under the direction of the latter. Authority should be granted the County Entomologist to promulgate rules which are consistent with the state law concerning the details of its execution as far as it relates to county work. He should be authorized to quarantine against the importation of nursery stock or plants of any kind from other counties, and to make such inspections as they may deem advisable of nursery stock or plants imported from other counties in the state or from other states or territories and from foreign countries. He should be authorized to require defoliation, treatment with insecticides or the fumigation of plants imported into the county from other counties, or of plants offered for sale within the county when necessary to prevent the spread of insect pests. He should be authorized to inspect nurseries, orchards, groves, vineyards, trees, vines, plants and fruits as far as practicable to protect the horticultural interests within his jurisdiction and to serve legal notices requiring specified measures for the control or eradication of insect pests when necessary. He should be authorized to enter upon any premises at any time for the purpose of performing any of the duties required of him by the law. Authority should be given to the county entomologists to regulate, with the approval of the county commissioners of the respective counties, the planting of new citrus groves so as to prevent in the future losses to owners of isolated groves or groves in isolated groups through the interference with the advantages of such isolation, also, so as to prevent new plantings interfering in any way with the control of the whitefly or other pests in groves already established.

7. When an orchard, grove or plants on any premises are found to be infested with an insect injurious to the horticultural interests of the county, and effective remedies or methods of eradication are known, then it should be the duty of the County Entomologist to declare the infested trees, plants or premises public nuisances and to serve a legal notice as heretofore stated requiring specified remedial measures or methods of eradication within a specified time. When any person or persons upon whom such notice has been served refuses or neglects to abate the nuisance as directed, or when, owing to the absence from the county of the owner or owners, it is impossible to serve the notice, it should be the duty of the County Entomologist to cause the nuisance to be abated by means of the most economical control measures available, including when necessary, the complete or partial destruction of the infested plants, fruits or articles. When performed by the entomologist or his authorized assistant, the expense should be borne by the county and become a lien on the property subject to legal action for recovery. Plants, trees or shrubs, which are not fruit producing,

and which are subject to infestation by species of insects injurious to horticultural interests, should be defined as public nuisances whether or not injurious insects actually exist thereon and it should be the duty of the County Entomologist with the approval of the county commissioners to condemn any such plants, trees or shrubs when necessary to protect said interests.

8. Regulations should be included in the state law governing the importation of plants into the state of Florida. It should be required that importations of plants be accompanied by a certificate of inspection from an authorized state or government entomologist or inspector; also by a complete invoice from the shipper showing the contents of the shipment and the place where the plants were grown. Any person, persons or common carriers bringing or causing to be brought into the state plants of any kind should be required to hold such plants, immediately notifying the County Entomologist or the State Entomologist in case no County Entomologist has been appointed. It should be the duty of the County or State entomologist to inspect such imported plants within twenty-four hours after receiving notice of their arrival. Such plants should not be delivered until the common carrier and consignee have each been furnished with a certificate of release by the proper entomologist or his duly authorized agent. If imported plants are found to be infested with injurious insects which are not of general occurrence in the county, the entomologist should be authorized to condemn or disinfect. In the former case the plants should immediately be shipped out of the state by the consignee or should be destroyed under the direction of the County or State entomologist at the expense of the consignee. If in the opinion of the entomologist fumigation with hydrocyanic acid gas or treatment with an insecticide will render the plants innocuous, the expense of such treatment as he may decide upon should be borne by the consignee.

9. The most important duty of the county entomologists in citrus fruit producing counties should be defined in the state law as promoting the horticultural interests of their respective counties by supervising the control of insect pests, particularly whiteflies, by organizing and aiding in the organization of citrus growers into local protective associations, in acting as advisors to such associations and individual owners and in coöperating with them in bringing insect pests into a condition of control and in maintaining this condition.

10. The State Crop Pest Commission should be required to meet once a year for the transaction of business. The State Entomologist should be designated as *ex officio* chairman and a vice-chairman and a secretary should be elected by the members. The commission should be authorized to declare quarantines prohibiting the impor-

tation into the state of designated species of plants from designated states and territories when the danger of importing any pest warrants such action. They should be authorized to take such steps and to transact such business as may be necessary to improve the methods of combating insect pests and to secure uniformity of rules and practices as far as practicable among the officials representing different counties or groups of counties. As state officers the members of this commission should be granted the same authority as specified for county entomologists.

11. The State Entomologist should be authorized to employ such assistants as are needed to inspect plants of all kinds imported from other states, territories or foreign countries and destined for points in counties in the state in which no county entomologists have been appointed, also to maintain quarantine stations at designated ports of entry. The State Entomologist or his agent should be authorized to destroy or disinfect fruit or plants received at such ports and found to be infested with insect pests which do not occur or are not of general distribution in the state. The duties of the State Entomologist should be further defined to provide for his coöperation with the county entomologists by importing and breeding beneficial insects and by the importation and dissemination of fungous diseases useful in the control of injurious insects, also by introducing into the state improved apparatus and methods used in the control of insect pests in other states or in foreign countries.

12. In addition to the foregoing provisions citrus growers should be protected in the use of insecticides at all times. It should be required that the manufacturer of every insecticide offered for sale in the state register his product by name, also the formula, at the office of the State Commissioner of Agriculture. Provisions for the analysis of these insecticides by the State Chemist should be made, and it should be declared unlawful for the registered name to be used for any other formula or combination of the ingredients than that recorded in the original registration. In other details the National "Insecticide Act of 1910" should be followed.

13. Suitable penalties should be prescribed for the violations of the law and for the intentional interference in any manner with its operation.

14. An adequate appropriation should be made for the work of the State Entomologist and for defraying the expenses of the members of the State Committee on Credentials and of the State Crop Pest Commission in connection with meetings, as their duties or the law may require.

Features to be Avoided in Drafting a State Horticultural Law

The State Committee on Credentials should be allowed to maintain a list of the most experienced economic entomologists available, without restrictions as to confining such list to residents of the state. Examinations for the position of County Entomologist should not be required, since among those whose experience should entitle them to consideration the results of an examination would be deceptive and set a false standard. In recognition of the great difference in the extent of horticultural interests in the different counties, the amount of the salary to be paid entomologists should not be specified or restricted in any way by the state law. No more points should be covered by the law than are necessary to secure effective results in the control of insect pests. Particular care should be taken that no duties impracticable or impossible to accomplish be imposed on any official.

Rules and Regulations by County Entomologists

With the authority given by the state law the rules and regulations which should be adopted by a County Entomologist—made effective if necessary through county ordinances—in important citrus fruit growing sections should include the following:

a. All china and umbrella trees, privets, cape jessamines, wild persimmons, prickly ash and other food plants of the citrus whitefly which are so located within the county limits as to be subject to infestation by the citrus whitefly and liable to interfere with control measures against this insect in citrus groves, or liable to aid in the further dissemination of the species should be ordered destroyed and further plantings of any of these trees or shrubs within the county limits should be prohibited.

b. All citrus nursery stock for planting within the county limits should be completely defoliated at the nursery where grown or before shipment into the county, with such exceptions as may be consistently made by the Entomologist.

c. Any person or persons engaged in general contracting for spraying, fumigating or other operations for the purpose of controlling whiteflies or other citrus pests or who may undertake under any form of agreement to assume the responsibility for spraying, fumigating or other operations except in the capacity of laborer or employee should be required first to obtain a license from the County Commissioners to perform such work. Such licenses should be granted only upon the recommendation of the Entomologist after satisfying himself as to the capability of the person or persons applying for the same and as to the suitability of the apparatus, fumigating tents or other outfits with which the work is to be performed.

d. With the authority to regulate new citrus plantings granted by the state law as recommended herein, it should be required that written permits to locate each new grove be obtained from the County Commissioners. These permits should be granted only upon the recommendation of the Entomologist following fixed rules as far as practicable, after he has made due examination of the surroundings and found that a citrus grove in the proposed location does not materially interfere with the control of the whiteflies in groves already established.

The Enactment and Operation of a Horticultural Law in Florida

Anyone familiar with the history of the whitefly in Florida, its methods of spreading, the important part that infested nursery stock and worthless china and umbrella trees have played in its dissemination and the present annual damage from the insect, cannot but realize that millions of dollars would have been saved to the state by a horticultural law enacted ten or fifteen years ago. Even if nothing more had been accomplished than the elimination of the more important non-fruit producing food plants of the citrus whitefly and the compulsory defoliation of citrus nursery stock before shipment from infested nurseries for planting in uninfested sections, such a law would have been a success and by having restricted the spread of the insects would have represented a saving at the present time of three quarters of the present annual losses, or more than three quarters of a million dollars per year in Florida alone. The establishment of quarantine stations at ports of entry as suggested in the law herein proposed, probably would incidentally have excluded the woolly whitefly (*Aleyrodes howardi* Q.) recently introduced at Tampa, Florida,[1] from Cuba and also several other insect pests of subtropical fruits introduced from foreign countries during the past few years.

Although the long delay on the part of the Florida citrus growers in demanding legislative action has resulted in great injury to their interests and in a broad sense to the business interests of the entire state, this injury is not entirely irreparable. Many of the most progressive citrus growers object that the difficulty in securing the necessary support would be so great as to make the attempt to enact and execute a horticultural law impracticable. A similar objection, only five years ago believed to be insurmountable, against the organization of citrus growers for the marketing of fruit on the California plan had the same value as determined by subsequent events, as objections which may now be raised against the organization of warfare against Florida's worst citrus pest. An effective horticultural law is practicable in Florida and the securing of public sentiment which is necessary for its support requires no more energy than was expended in the organization of the Florida Citrus Exchange two years ago.

It should be recognized that the idea of a horticultural law in Florida will meet serious objection as long as its proper scope and greatest opportunities of usefulness are misunderstood. The principal duties of county entomologists according to the plan proposed by the writer are outlined in paragraph nine of the suggested features of the horticultural law. All citrus growers who desire to maintain their groves

[1]Bul. 64, Part VIII, Bur. Ent. U. S. Dept. Agric.

in the highest state of productiveness should welcome the assistance and coöperation which such a law would provide. These growers usually need protection from neighboring citrus groves whose owners are absent, leaving incompetent men in charge, or whose owners for other reasons are indifferent or would fail to coöperate in whitefly control except under compulsion. Even in such cases, however, the law would operate to advantage since, if the owner failed to take action when directed to do so, treatment by spraying or fumigation would be done by the county, the owner would be compelled to pay for the work and incidentally find it necessary to profit by the control of the insects.

When citrus groves or trees are of so little value as not to justify the expenditures necessary to whitefly control, the complete destruction of the trees is advisable and will naturally follow the administration of the law. There are today in Florida thousands of citrus trees which are a detriment to the citrus industry of the state; trees which are unproductive and which occupy space which could be more profitably used by the owners. In other cases growers are financially unable to control the whitefly owing to their holdings being too extensive. In such a case the enforcement of a law requiring the control of the whitefly, necessitating the disposal of a portion of the grove concerned, would be an actual benefit to the owner as well as to the community interests. In many cases one half the acreage now under one ownership, better cared for culturally and with the insect pests brought under control would yield a net profit as large or much larger than the entire property under the present conditions.

Still further changes are demanded and would naturally follow the operation of a horticultural law with advantage to all concerned. The control of many insect pests has made necessary extensive changes in farm and orchard practices. Frequently the changes in the methods of culture developed by an entomological investigation are in the main changes which would be of advantage even if adopted before the appearance of the insect pest concerned. This is the case with the whiteflies which attack citrus trees in Florida.[1] Much has been accomplished in the last few years in the adaptation of fumigation and spraying to whitefly control under Florida conditions, but radical measures are frequently required to place the use of these direct remedies upon the most practicable and profitable basis. These measures consist in reducing the height of citrus trees, when excessive, and in reducing the number of trees to the acre when they are so closely planted as to interfere with control measures. In the opinion of the writer the height of citrus trees wherever the citrus or cloudy winged whiteflies occur should not exceed twenty-five feet. The branches of adjacent trees

[1]Bul. 76, Bur. Ent. U. S. Dept. Agric., p. 14; Circular 111, p. 10–11.

should not interlock since this seriously interferes with both fumigation and spraying.

Briefly stated, citrus groves should be made to conform to the requirements of effective and economical whitefly control regardless of the apparent sacrifices. To illustrate the situation: If the normal annual rainfall in Florida were to be decreased from fifty inches to ten inches a radical change in the methods of producing a citrus crop would be required and the fact that comparatively few citrus groves are at present piped or trenched would not make irrigation impracticable or any the less effective. Similarly the fact that many citrus groves in Florida are at present very poorly adapted to the use of direct remedies for whiteflies does not detract from the availability of these remedies or furnish a sound argument against the adoption of a systematic campaign for whitefly control along the lines outlined in this paper.

The Search for Enemies of the Citrus Whitefly as Affecting the Desirability of Immediate Action toward Control by Direct Means

For years Florida citrus growers have been interested in the possibility of foreign explorations locating the original home of the citrus whitefly and in the possibility of discovering there effective natural enemies. In the investigations of whiteflies begun in 1906 efforts in this line have naturally been preceded by field investigations which were certain to give practical results. The principal results of these investigations are now being published by the Bureau of Entomology. As a result of our present knowledge of the whiteflies, contributed to by the investigations of the United States Department of Agriculture and by the Florida Experiment Station, citrus growers in Florida are now confronted by the opportunity to begin at once a practicable organized effort to bring the whiteflies into a state of control. The question naturally arises: Is such an undertaking advisable as long as there exists the possibility of discovering and introducing an effective natural enemy? This can be determined only by means of an examination of the history of similar efforts to discover and introduce beneficial insects. The following facts and conclusions are based upon an examination of most of the important literature on this subject:

1. There are on record more failures than successes in the endeavors made in the various parts of the world to control imported insect pests by means of natural enemies secured by foreign explorations.

2. The success of the Australian lady bug (*Novius cardinalis*) in controlling the cottony cushion scale in California, resulting in complete commercial control within a few months after its introduction,

is generally conceded by entomologists to be extraordinary and not to be expected except in rare instances.

3. Ordinarily it may be expected that it will require several years for an introduced beneficial insect to become effective over a large extent of territory.

4. Many attempts may be necessary before the successful introduction of a beneficial insect is accomplished.

5. There are instances of complete failures of repeated attempts to introduce beneficial insects into new regions, the reasons not being definitely known, but presumed to be due to the differences in climatic conditions.

6. Parasitic or predatory insect enemies may appear to accomplish the complete control of an insect in its native home and prove of little commercial importance against the same insect pest when introduced into another region.

7. There is a danger of native hyperparasitic insects attacking the introduced beneficial species and preventing its multiplying rapidly enough to become useful.

8. The apparent control maintained by a beneficial insect and observed by foreign explorers may be due to characteristics of the food plant of the insect pest. The food plants in the native home may have become adapted to resist the injurious effects of the insect and the predaceous or parasitic enemies may consequently appear effective when in reality such enemies would be ineffective without these plant adaptations.[1]

9. Notwithstanding the preponderance of unfavorable probabilities and possibilities, the importance of making every effort to secure successful natural enemies, or enemies which will contribute to a condition of successful natural control of serious insect pests is second only to the importance of taking immediate steps to control such pests by the means at hand.[2]

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[1] This conclusion is suggested by a memoir of Prof. Paul Marchal (English translation in *Popular Science Monthly*, Vol. LXXII, page 417) and appears to the writer as well within the range of possibilities in the case of the citrus whitefly. The discussion of the food plant adaptations of this species by the present writer and Dr. E. A. Back in a recent publication shows that the pomelo or grape fruit possesses certain characteristics which are decidedly unfavorable to the multiplication of the insect to an injurious extent. The foliage, of the orange in the native home of the whitefly therefore, would have only to adapt itself so as to possess the same or similar characteristics as exist in the foliage of the Florida types of grape fruit in order to become nearly immune to the insect.

[2] The words of Prof. Marchal may be aptly quoted in this connection (*Popular Science Monthly*, Vol. LXXII, page 419): "Confidence in the assistance we can get occasionally from parasites and predaceous insects should not make us lose all prudence nor prevent us from seeking a guard against the perils that surround us, in organizing at our large ports an inspection and disinfection service—and in a general way taking every measure possible to protect our crops."

The foregoing more or less generalized conclusions applied to the present whitefly situation in Florida lead to the belief that even if an effective natural enemy of the citrus whitefly were already successfully established in that state and had shown its ability to thrive there, whitefly losses would in all probability amount to three or four million dollars before a condition of commercial control could be accomplished in the average grove. Florida citrus growers have no better justification for inactivity in the control of the citrus and cloudy wing whiteflies pending the results of foreign explorations than have California citrus growers for abandoning fumigation and spraying for the control of the red scale (*Chrysomphalus aurantii*), purple scale (*Lepidosaphes beckii*), black scale (*Saissetia oleæ*) and the citrus mealy bug (*Pseudococcus citri*) in view of the efforts being made by the State Commission of Horticulture to subdue these leading citrus pests by importations of their natural enemies.

Without going into the details of the history of the importation of the many natural enemies of these scales into California during the past twenty years, it is sufficient to say here that none of the species mentioned is at present controlled to a satisfactory degree by the introduced natural enemies and that the expense of combating these pests in California citrus groves is not materially affected by the introductions. The recognition of this fact does not detract from the true benefits of the work, since the results cannot be measured at present upon such a basis. It seems unlikely that there exists a single species of insect enemy in the case of any of the four pests here referred to which is capable of accomplishing complete and satisfactory control. Combined, certain of the natural enemies may be sufficient but a single minor omission may leave a broad gap between success and failure from a commercial standpoint. It appears to be the present endeavor of the California Commission of Horticulture to supply these omissions.

During the next five years there is as much likelihood of the whitefly problem in the Gulf Coast citrus regions being temporarily disposed of by a freeze equally disastrous in its consequences to those of the winter of 1894–95 as there is likelihood of a general condition of control by natural agencies being brought about during that time. The citrus growers of Florida, Louisiana and Texas have before them the opportunity to profit by the history of the efforts to control citrus pests in California by means of natural enemies and while efforts to bring about a condition of natural control of the whiteflies should be increased rather than diminished, no time should be lost on account of such efforts in placing the control of these insects upon an organized business basis and in insuring against the further importation and establishment of undesirable insects.

LEAKAGE OF FUMIGATION TENTS

By C. W. Woodworth

The purpose of the present paper is the discussion of the significance of the leakage factor in fumigation and the development of a dosage system which shall be based upon the varying conditions of leakage tents found in actual operation in the field.

Every one unacquainted with the facts regarding the conditions under which fumigation is carried on will be inclined to enquire, "Why have any leakage at all?" No doubt there can be and should be much improvement in this respect but under the best conditions likely to be obtained, this factor will still remain a very important element in calculating the dose to be used.

The practice of fumigation has been developed without scientific supervision and the dose given to trees of varying sizes was determined by "cut and try" methods and the actual system used as a result of practical experience of hundreds of fumigators developed through a quarter of a century of practical work is entirely at variance with the suggestions of the scientific men who first developed the method.

Many present, perhaps, do not appreciate that fumigation is not only the most important insecticide operation in California as measured by its cost, but also that it is more important than the combined insecticide work of any other state or of any foreign country.

The development of the process to such proportions, amounting to an outlay of now about $500,000 per year, could only have occurred where the average practice has become approximately correct.

The first attempt to develop a system for the calculation of the dose consistent with the practice of fumigation was in 1903.[1] At that time there was no data in existence for dose calculation corresponding even approximately with the practice, and the scheduling of orchards was exclusively by the judgment of the fumigator, acquired by observing the work of the other fumigators and corrected from time to time by results obtained in fumigation.

Under such conditions there was bound to be much irregularity in individual cases even though the average results were certainly very dependable.

Several thousand measurements were made at that time showing that the average dose of four ounces corresponded with an average ten-foot tree; a dose consistently used by no fumigator but nevertheless that established, and firmly established, by practice for the destruction of the black scale.

[1]Bulletin No. 152, California Experiment Station.

This dose may be considered as ample or perhaps a little high, for the reason that it represents the average of all fumigation work though some of it (not a very large amount, however) was for red and purple scale work, both of which usually receive more than the black scale, and because fumigators would be more liable to give more than necessary since a slight injury to the tree is not considered as bad as a failure to kill the scale.

The measurements also gave data showing that the rate of increase of dose for larger trees and of decrease for smaller ones did not correspond with the changes in volume. While there was a great deal of diversity in the practice of different fumigators, they agreed in the one fact that the rate of change in dose was strikingly less than the rate of change in volume.

The suggestion made at that time based on the results of this study was that the area of the surface of the tent instead of the volume enclosed might be adopted as the measure of the dose. This suggestion has been followed by several writers and experimentors and is today the only basis of calculation that approximates the actual average practice.

At the time the above suggestion was made, it was clearly understood that the area basis of calculation gave only an approximation to the correct dose and did not by any means represent an accurate allowance for any particular degree of leakage. A recent student (Woglum) has offered a table calculated by the formula dose $= v \times \frac{a}{v}$ which he supposed did accurately allow for leakage but of course is only the area basis suggested by me years before.

Last year in presenting the methods available for scheduling trees for fumigation, the need of some method of measuring the leakage of tents and of accurately adjusting the dose to the leakage became very evident. Accordingly the present season over 5,000 determinations were made in the field of the leakage of fumigation tents in actual operation and in many cases of the same tent under varying weather conditions. The details of these results cannot be given at this time and we shall limit ourselves to the one problem of the application of the averages thus obtained to the production of a table of dosages.

Of course such a table must be taken as only an approximation but there seems to be sufficient data at hand to warrant us in considering this table accurate enough for practical use.

The other problems concerned are now the subject of investigation and will be presented in due time.

In the absence of accurate experimental data relative to the laws governing the escape of gases through such a net work as presented by the weave of a fumigation tent, we are forced to the assumption that

the gas follows the laws of diffusion to the extent that the rate of escape is directly proportional to the differences in density. All the data at present at hand accords with the assumption with the limits involved; it is probably a very close approximation to the facts.

The *amount* of *leakage* may be stated in terms of percentage of the area of the surface; this is readily determined by finding the area of an orifice which will permit the flow of air at the same rate as through a portion of the canvas tested. The ratio of these two areas gives the percentage of leakage. For practical purposes it is better to determine the leakage of a doubled canvas and use this figure since when this is done one can easily make determinations at any part of the tent. The average leakage of doubled fumigation tents is .25% and the common range from .1% to .4% depends on the character of the canvas and on variations in weather conditions.

The *density of the gas* depends upon the relation of the dose to the volume of the tent. According to the universal practice of fumigators, the density used will be greater in small tents and less in large tents. If the dose were made exactly proportional to the area then the density would be represented by the ratio $\frac{a}{v}$ and be therefore inversely proportional to the diameters in trees of similar shapes. Thus it will be seen that while the area basis of scheduling may give a rough approximation of the dosage of the average leakage .25%, it will clearly not apply even roughly to tents showing any other per cent of leakage.

The *effect of leakage* upon the density in a small tent is greater than in a large tent because each unit of surface covers less average depth of gas; the quantity escaping per minute depending upon the density. It is evident that if a gram escape from each unit of surface the first minute from each of two tents, the remaining gas is a larger percentage of the original amount in the case of the larger tent. The volume behind each unit of surface of tent is indicated by the ratio $\frac{v}{a}$ and for tents of uniform shape is directly proportional to the diameters.

Stated in other words the time required to reduce the gas to 50% of its original strength is twice as long in the case of a tree 20 ft. in diameter as would be required for a tree 10 ft. in diameter when each is covered with a tent showing the same percentage of leakage.

The *per cent of leakage* determines the time required to reduce the density to any given percentage. Very evidently the size of the orifice in the escape either of a liquid or of a gas determines the rate of escape. Two openings will cause it to pass out in half the time and so will one orifice with twice the effective area. The density of the gas in a tent of .2% leakage will require twice as long to drop to 50% as it would in the same sized tent having .4% leakage.

The *time required to kill* will be somewhat dependent upon the density of the gas. Years ago thirty minutes were employed for fumigation but all fumigators now use forty to fifty minutes. One of the investigations now under way is the determining of the killing strength of gas for different times of exposure.

We do not know when the maximum density of gas is obtained in the generation which sometimes takes as much as fifteen minutes; it is probable that a greater or less time elapses after the killing has been accomplished before the tents are actually removed. Under average conditions the present period may be considered justified. When we have sufficient data we may be able to reduce the time in certain cases and advise the extending of it in others. For the present, however, we must accept the time and suppose that the dose of four ounces for a ten-foot tree maintains the killing strength of gas for the necessary period under the average conditions of leakage and it is not necessary to know exactly what this period is.

To calculate the dose for trees of different size and for tents of different leakage we need but to know that the above dose applies to .25% leakage for a 10 ft. tree and that in the case of other trees the ratio of increase or decrease of dose corresponds approximately with the area, that is, when the volumes are in the ratio of 1:8, the dose is in the ratio of 1:4.

The correct dose for a tent consists of two factors, (1) the theoretical amount necessary to kill when the tent is tight; (2) the amount of increase to allow for leakage. When one tent has twice the diameter of another, provided they are of the same shape, they have the ratio 1:8 in volume and if 1 is the theoretical dose of the smaller, 8 is the theoretical dose of the other. The second factor for these two tents consists of numbers, one the square root of the other. If half the gas escapes in ten minutes, half of the remainder will have escaped at the end of twenty minutes. Now with a tent of twice the diameter the loss in twenty minutes will only be that occurring in the smaller tent in ten minutes. The dose to compensate for the losses in these two tents during twenty minutes would require in one case a doubling and in the other case a fourfold increase. The ratio between these two rates of increase is that one is the square root of the other.

The formula would be

dose $d^3 \times \sqrt[d]{1}$
in which d = diameter and 1 = leakage factor.

Our unit diameter is 10 ft. and the leakage factor that satisfies the condition of the average dosage practice is four as shown by the following calculation:

	10 ft.	20 ft.
Theoretical	1 oz.	——
Leakage factor	4 oz.	$2^3=8$
	——	$\sqrt[2]{4}=2$
Product = dose	4	——
		16

Since the amount of leakage has precisely the same effect on the leakage factor as the size of tent the formula becomes

$$\text{dose} = d^3 \text{ x } {}^{pd}\sqrt{1}$$

in which p = per cent of leakage with .25 as the unit.

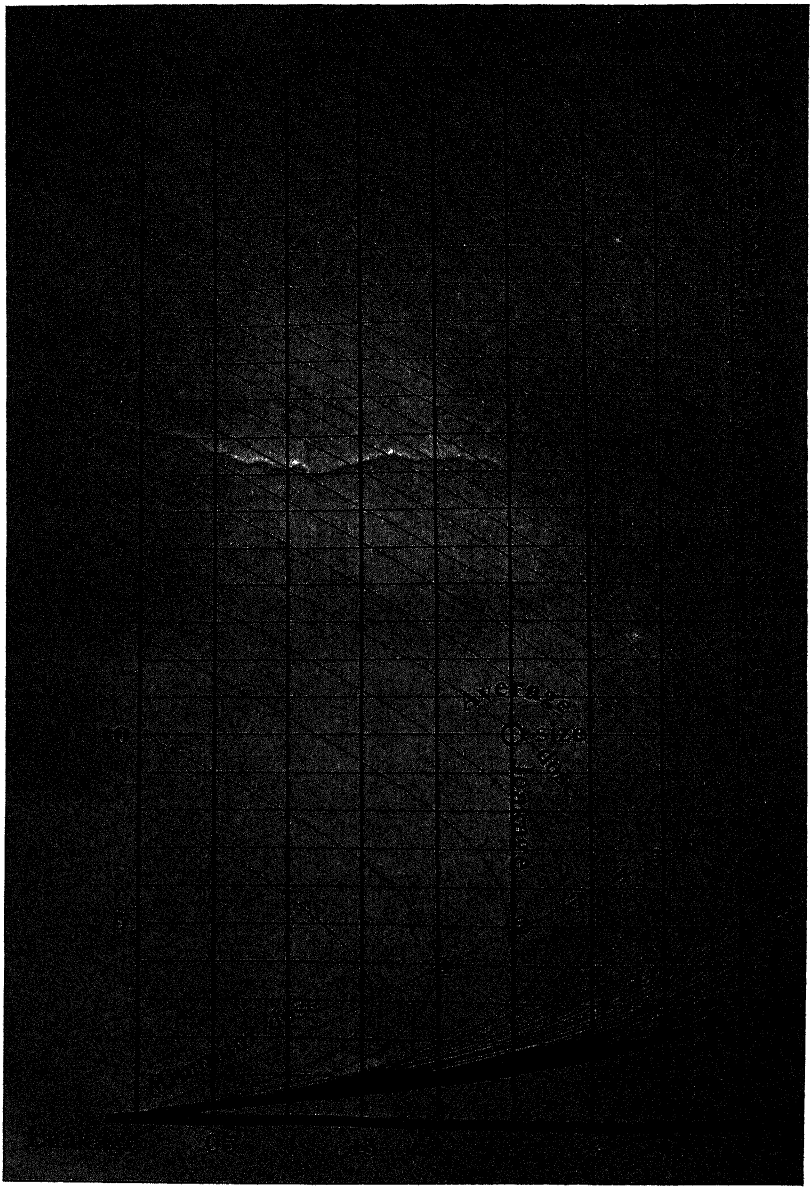
Applying this formula tables were calculated for the dose corresponding to the size of the tree and the degrees of leakage indicated by the straight lines of the chart and the curves indicating the dosages were drawn in accordance with these calculations.

The table is based as already indicated upon the actual practice of fumigators as regards the dose for a 10 ft. tree with average leakage. The portions of the table nearest this average therefore can be looked upon as having an accuracy independent of the calculations.

The most probable error is in the determination of 4 as the leakage factor; 4 is right if 16 oz. is right for a 20 ft. tree but most fumigators in fact give a 20 ft. tree less than 16 oz. which would indicate a larger factor. In case the leakage factor should be more than 4, the result would be the slight widening of all the curves, making still more pronounced the difference between the dosage of the tight and leaky tents of the same size.

It seems safe to say that the importance of leakage is not less than that indicated by the chart.

Of recent years there has been a very general appreciation of the necessity of measuring the sizes of trees when scheduling. There is no doubt that grave mistakes are made where measuring is not done but no matter how accurate one may be in the measuring of a tree, this chart shows that the fumigator may make the dose only a quarter as large as it should be or three or four times as great as is necessary in case the tents are leaky or tight. No mistakes anywhere near as large as these were found in all of the thousands of measurements made by us to test the relation of dosage to size of tree. We are led to conclude, therefore, that it is very much more important to measure the leakage than to measure the size.



Fumigation dosage for black scale based on size of tent and leakage of gas

PLANT LOUSE NOTES, FAMILY APHIDIDÆ

(*Concluded*), Plate 16

By C. P. Gillette

Rhopalosiphum rhois Monell.—This species was taken on sumac (*Rhus* sp.) on Belle-Isle, Detroit, and at Fort Lee, and was extremely abundant on wild sumac about Georgetown, D. C. At the latter place the sumacs had been so severely attacked that much of the foliage had the appearance of having been frosted, and many of the leaflets had fallen. The third joint of the antenna has from five to eight slightly raised sensoria in the specimens collected. The antenna and cornicle of the summer winged form are shown in figures 1 and 1a.

Rhopalosiphum capreæ Fab.—This species was taken at Amherst and Webster, Mass., and at Fort Collins, Col. It has the willows (*Salix* species) for its winter hosts and several species of Umbelliferæ for its summer food plants. For illustrations and fuller notes on this species and *R. pastinacea* see an article by the writer in the June, 1911, number of the Journal.

Amphorophora rubi (Kalt.)
Aphis rubi, Kaltenbach, Walker.
Siphocorine rubi, Koch.
Siphonophora rubi, Buckton.
Amphorophcra rubi, Schouteden.

The above seems to be the synonomy of this species. Examples were taken by Mr. Bragg at Webster, Mass., on *Rubus occidentalis*. It was also taken on the same host plant at Fort Collins, Col., July 7–31, 1908. The hind legs are very long, the tibiæ being nearly as long as antennal joints 3, 4, 5, and 6 together. For antenna and cornicle of alate summer form see figures 2, 2a and 3. These specimens from Massachusetts agree with specimens of this species from *Rubus fruitcosus* at Southwater, Sussex, England, July 2, 1909, collected and sent to me by Prof. T. D. A. Cockerell, except that the specimens from Europe are a little smaller.

A very similar species taken by Mr. Bragg at Lawrence, Kans., differs by having cornicles decidedly shorter and having joint 4 of the antenna in the alate viviparæ well set with sensoria.

Myzus cerasi Fab.—Taken at Portland, Mich., Rochester and Albany, N. Y., and Portland, Hood River and Corvallis, Ore., on *Prunus cerasus;* at Webster, Mass., on *P. serotina*, and on *Prunus emarginata*, var. *mollis*, at Portland, Ore. This species is abundant on the eastern slope, and occurs in a few localities only on the western slope.

in Colorado on both the sweet and sour cherries. It breeds very rapidly early in the season, often nearly covering the foliage and greatly injuring the crop. Figures 4 and 4a show the antenna and cornicle of the alate viviparous female.

Myzus ribis Linn.—This species was taken at Chicago and at Webster, Mass., on the garden currant, *Ribes rubrum*. Fairly common but not abundant about Fort Collins and Denver. Readily recognized by its small size, yellow color, and the puffed red blisters of the upper surface of the currant leaves caused by the punctures of the lice upon the under surface. Figures 5 and 5a show the antenna and cornicle of alate viviparous female taken at Fort Collins, 7–9– '07.

Myzus rosarum Walk.—Abundant on rose bushes in Detroit and Portland, Ore. An extremely abundant species on roses in Fort Collins, often ruining the flowers, or even the buds before they open. Especially bad on the climbers. The antenna of the alate viviparous form taken at Fort Collins, 6–10– '09, is shown at figure 6, the cornicle at 6a. The hind tibia of an oviparous female is shown at figure 7 and the cornicle at 7a. The last was taken from rose at Fort Collins, November 5, 1909. We have also taken this species upon cultivated strawberry and upon *Potentilla* sp. Several males and females have been taken on all the above.

Myzus persicæ Sulz.[1].—This louse was only noted at Webster on garden vegetables, though it is probably common through most of the states traversed. It is abundant every year in Colorado. The peach and plum are the chief fall, winter and spring hosts, though a considerable proportion of the fall lice remain viviparous and hibernate on various herbaceous plants out of doors and upon various greenhouse plants, notably the snapdragons and the carnations indoors. See illustrations in Plate 6, of Journal of Economic Entomology, October, 1908.

Phorodon humuli Sch.—Taken on hop vines at Detroit and at Webster. This louse is fairly common on both eastern and western slopes in Colorado and we have known it to remain on the plum in small numbers throughout the summer. I have never seen it injuriously abundant on the plum in this state. Specimens from Sussex, Eng., sent by Professor Cockerell, seem in every way like our American examples. The antenna and cornicle of the alate summer form are shown in figures 8 and 8a.

Macrosiphum tanaceti Linn.—Taken at Webster, Mass., and Kansas City by Mr. Bragg from *Tanacetum vulgare;* very abundant. The entirely black antennæ, cornicles, cauda and legs; the straight,

[1]For illustrations of this species see Bulletin 133 Col. Exp. Sta. or Journal of Economic Entomology, 1908. p. 359.

slightly tapering and moderately long cornicle, and the reddish brown abdomen are characteristic of this species. A very similar but apparently distinct species occurs on *Artemisia ludoviciana* in northern Colorado. See figures 9 and 9a.

Macrosiphum tulipæ Monell.—A very common louse where the tulip tree, *L. tulipifera*, was seen at Lansing, Fort Lee, Washington, D. C., Kansas City, Amherst and Webster. Figures 10 and 10a.

Macrosiphum rudbeckiæ Fitch.—Taken on golden glow at Detroit and Webster. This is a very common species on *Rudbeckia*, both wild and cultivated, on both slopes of the mountains in Colorado. We have taken it upon *Solidago* in a few instances. The shorter cornicles alone will separate the fall adults from those of *solidaginis*. See figures 11, 11a, and 12.

Macrosiphum sonchi Linn.—What I believe to be this species was taken on *Sonchus* at Webster, Mass., and at Washington, D. C. Notice the remarkably long third joint and flagellum of the antenna. A great deal of collecting from *Sonchus* in Colorado has not given this species. Figures 13 and 13a.

Macrosiphum erigeronensis Thos.—Taken at Fort Lee on *Erigeron* sp. The species is also fairly common at Fort Collins on *Erigeron canadense*. There seems to be considerable variation in the length of the antennæ between the New Jersey and the Colorado species, the former being the shorter. The drawings, figures 14, 14a and 15 are from an alate viviparous female taken July 26 at Fort Collins. There may be two species involved.

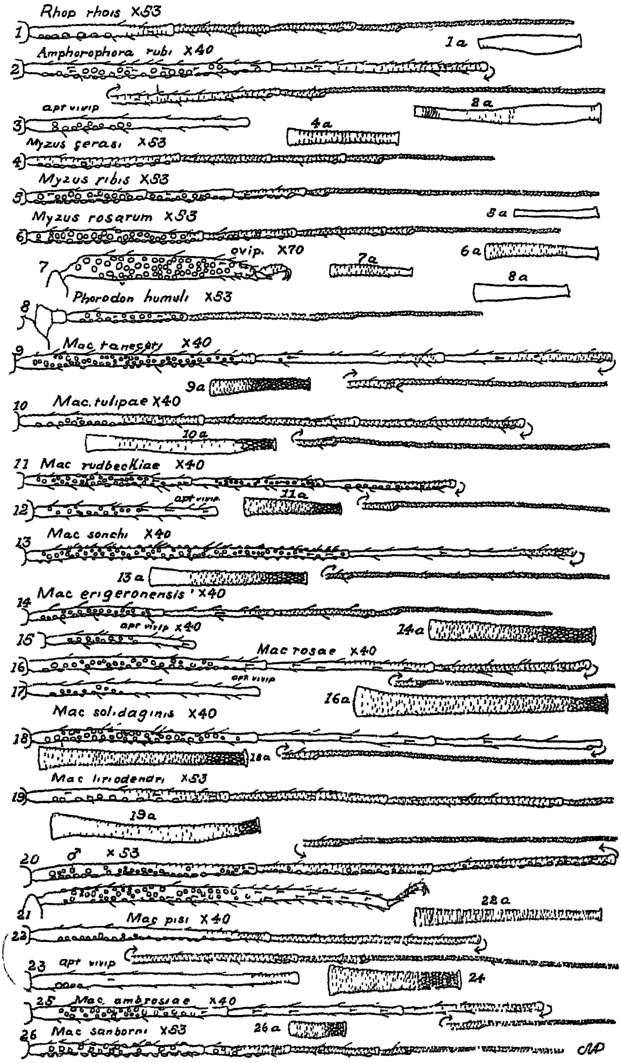
Macrosiphum rosæ Linn.—Taken at Chicago, Lansing, Detroit, Webster and Wood's Hole, and in both green and pink forms on wild roses at Portland, Ore. Appears to be common wherever roses are grown. This is a common species on both the eastern and western slopes in Colorado. Taken in both colors, green and red. Figures 16, 16a and 17.

Macrosiphum solidaginis Fab.—Taken on *Solidago* at Washington, Webster and Portland, Ore., and on *Aster* sp. at Albany and Portland, Ore. This is a common species on *Solidago* about Fort Collins and Denver. See figures 18 and 18a.

Macrosiphum liriodendri Monell.—Taken on leaves of *Liriodendron tulipifera* at Washington, agree with specimens of the same species in the collection taken by Mr. J. T. Monell at St. Louis, Mo., and others by Mr. J. J. Davis taken at Urbana, Ill. An apterous oviparous female from Davis has the hind tibiæ well covered with sensoria (?) in proximal two thirds. The males are winged. See figures 19, 19a, 20 and 21.

Macrosiphum pisi Kalt.—Taken from *Trifolium pratense* at

Plate 16



Structure of Aphididæ

Albany, N. Y., July 1. I also have specimens from Maryland sent me by Prof. W. G. Johnson. The specimens were taken by him from garden pea, *Pisum sativum.* This is a very abundant species in Colorado on both eastern and western slopes where we have taken it from the garden pea, *Lathyrus odoratus*, alfalfa, *Medicago sativa;* and sweet clover, *Melilotus alba.* The examples taken from these plants seem identical with specimens sent in by Professor Cockerell that were taken from pea vines in Sussex, Eng., July 4, 1909. This species has remarkably slender cornicles; the antenna is ringed with black at the distal ends of joints 3, 4 and 5, and in the apterous viviparous female there are from two to five small sensoria near the base of the third joint. See figures 22, 22a, 23 and 24. The drawings are from the European specimens.

Macrosiphum ambrosiæ Thos.—Taken at Lawrence, Kans., only. This is a very abundant louse about Fort Collins every year and especially on *Ambrosia trifida.* We have also taken it on *Rudbeckia,* and *Iva xanthifolia.* See figures 25 and 25a.

Macrosiphum sanborni Gillette.—Taken on chrysanthemums growing out of doors at Hood River, Ore. This louse is common and often quite destructive to chrysanthemums in greenhouses in Colorado. Figures 26 and 26a.

Plate 16. The following figures of antennæ, cornicles and tibiæ of Aphididæ are from the winged viviparous forms unless otherwise designated: 1 and 1a, *Rhopalosiphum rhois;* 2 and 2a, *Amphorophora rubi*; 3, third antennal joint of apterous female of same; 4 and 4a, *Myzus cerasi;* 5 and 5a, *Myzus ribis;* 6 and 6a, *Myzus rosarum;* 7 and 7a, hind tibia and cornicle of oviparous female of same; 8 and 8a, *Phorodon humuli;* 9 and 9a *Macrosiphum tanaceti;* 10 and 10a, *Mac. tulipæ;* 11 and 11a, *Mac. rudbeckiae;* 12, third joint of antenna of apterous form; 13 and 13a, *Mac. sonchi;* 14 and 14a, *Mac. erigeronensis;* 15, the third joint of antenna of apterous form; 16 and 16a, *Mac. rosæ;* 17, third antennal joint of apterous form; 18 and 18a, *Mac. solidaginis;* 19 and 19a, *Mac. liriodendri;* 20, male; 21, hind tibia of oviparous female of the preceding; 22 and 22a, *Mac. pisi;* 23 and 24, antenna and cornicle of oviparous female of the preceding; 25 and 25a, *Mac. ambrosiæ;* 26 and 26a, *Mac. sanborni.*

The amplification is indicated with each figure. Original, M. A. Palmer, Delineator.

AN ANNOTATED LIST OF THE LITERATURE ON INSECTS AND DISEASE FOR THE YEAR 1910

By R. W. Doane, *Stanford University*

While the year 1910 gave us no positive new discoveries in regard to the relation of insects to disease, it nevertheless marked important advances in the study of several diseases dependent on insects for dissemination.

As during 1909, greatest interest centered around the studies in regard to Sleeping Sickness. Following Thimm's Bibliography of Sleeping Sickness, published late in 1909, is his subject index to this bibliography, which is a great help to any one studying the subject. The monthly list of publications given in the bulletins of the Sleeping Sickness Bureau contains more than four hundred references to papers and reports published on this subject in 1910. Many of these deal with the method of transmission of the trypanosome and its development in the tsetse fly. It is now believed that mechanical transmission of the parasite rarely, if ever, occurs, and it has been definitely shown that the trypanosome undergoes a development in the tsetse fly lasting from eighteen to thirty-four days.

Doctor Sambon's investigations on the cause of pellagra, and the announcement that he finds that it is transmitted by a *Simulium*, have excited a great deal of interest and comment. For some time Doctor Sambon has held that there is a definite relation between the disease and these flies. As a result of last season's investigations in Italy he believes that he has collected abundant evidence to prove that these flies are responsible for the dissemination of the disease. The Italian government has been the first to take any definite steps toward testing this theory, and has appointed a commission to examine the evidence and to formulate any changes in the existing laws that it may be deemed advisable to make on account of the advances in our knowledge of the disease. American physicians are slow to accept this theory. At least they are waiting to be shown that the flies and the disease always go together in this country, as Sambon claims that they do in Italy. It will take most conclusive evidence to establish this new theory in the minds of those who have been working so long on the relation of maize to the disease. The present year should see much work done on this problem in America.

The death of Dr. Howard T. Ricketts in Mexico marks the passing of one of the most promising investigators in the field of preventive medicine. Although still a young man he had already accomplished much. It is principally to him that we owe our knowledge of the

relation of ticks to spotted fever. For some time before his death he had been working on the possible relation of insects to typhus fever. It was while carrying on these studies that he contracted the disease which ended fatally. But he had succeeded in gathering much valuable data, and his experiments, taken with those of others, leave little room for doubt that the common body louse (*Pediculus vestimenti*) is responsible for the transmission of the disease.

"The Prevention of Malaria," by Doctor Ross and others, is one of the most important additions to our literature in regard to the relation of mosquitoes to disease. Doctor Howard in his "Preventive and Remedial Work against Mosquitoes" sums up our present knowledge in regard to the subject treated in the bulletin. It is to be noted that in this publication the well-known *Stegomyia calopus* masks under the name *Aedes calopus*. Most workers will be more content to accept Theobald's decision and go back to the old name *Stegomyia fasciata*. Part five of Theobald's "Monograph of the Culicidæ of the World" is a most important contribution to the systemic literature of this family.

Early in November press dispatches announced that the first case of yellow fever had appeared in Hawaii. A sailor on one of the Japanese cruisers that had just arrived from Mexico was found to have the disease and the ship was held in quarantine. The utmost vigilance will be necessary to keep this disease out of these and the other tropical islands of the Pacific.

Much has been written about the relation of flies to typhoid fever and other diseases but with the exception of Doctor Currie's report on the relation of flies to leprosy, but little new evidence has been brought forth.

Several important articles on fleas and plague have appeared in various journals and reports. Mitzmain's papers have given us many interesting facts in regard to the bionomics of the flea. McCoy and others have shown the close relation existing between the rats and the ground squirrels. Bulletin 30 of the Pub. Health and Marine Hospt. Service on "The Rat and its Relation to the Public Health," contains several important articles.

The "Bulletin of Entomological Research," the first number of which appeared early in 1910, promises to be of particular interest to workers along this line. It is issued by the Entomological Research Committee (Tropical Africa) appointed by the Colonial office. The committee is composed of several prominent workers in tropical medicine and entomology. Besides several articles relating to various phases of tropical entomology there are many shorter articles and notes that often contain valuable bits of information.

The following list makes no claim to completeness, but is believed to include most of the English and American publications. Only a few of the Continental papers are included. It may serve as a supplement to the bibliography given in my "Insects and Disease."

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Minchin, E. A. and **Thomas, D.** Transmission of *Trypanosoma lewisi* by rat fleas. Proc. Roy. Soc. series B, 82 (1910), p. 273–285. Show that *C. fasciatus* can transmit *T. lewisi* from infected to non-infected rats. Transmission not direct, but parasite must undergo a development of six or seven days in the flea.

Swellengrebel, N. H. and **Strickland, C.** The development of *Trypanosoma lewisi* outside of the vertebrate. Parasit., September, 1910. Experiments show that it develops normally in *Ceratopsyllus fasciatus;* irregularly or incompletely in the rat louse or bedbug, and not at all in the tick (*O. moubata*).

Strickland, C. and **Swellengrebel, N. H.** Notes on *Trypanosoma lewisi* and its relation to certain Arthropoda. Parasit., December, 1910. Fleas, lice, bugs, ticks and mites were experimented with but the parasite was transmitted only by the flea.

Thimm, C. A. Subject index to the bibliography of trypanosomiasis. Pub. by the Sleeping Sickness Bureau, 1910.

The Sleeping Sickness Commission of the Royal Society, composed of David A. Bruce, A. E. Hamerton, H. R. Bateman, and F. P. Mackie, published the following papers in the Proc. of the Royal Soc. series B, vol. 82, 1910:

Amakebe: A disease of calves in Uganda, p. 256–272. This disease of calves corresponds to East Coast Fever of adult cattle and is carried in the same way by *Rhipicephalus appendiculatus* (brown tick), *R. evertsi* (red-legged tick), and *R. simus*, all common in Uganda.

The development of trypanosomes in tsetse flies, p. 368–388. Show that *T. gambiense* and other species multiply in the gut of *Glossina palpalis* and the flies become infective, on an average, thirty-four days after their first feed, and may remain infective for seventy-five days.

Trypanosome diseases of domestic animals in Uganda. 1. *Trypanosoma pecorum*, p. 468–479. This parasite causes an important disease of cattle and is probably carried by a *Tabanus* and not by *Stomoxys*.

Experiments to ascertain if cattle may act as a reservoir of the virus of Sleeping Sickness, p. 480–484. Experiments proved that they may do so. Healthy animals may be infected from them by means of *Glossina palpalis*. Cattle in the fly area naturally harbor *T. gambiense* and it is therefore possible that cattle and antelope may keep up the infectivity of the fly for an indefinite period. Up to the present time there is no proof that this actually takes place in nature.

"Muhinyo," a disease of natives in Uganda, p. 485–490. This is Malta Fever and is conveyed from the goat to man by the drinking of the goat's milk.

The natural food of *Glossina palpalis*, p. 490–497. In the first series 27 per cent of the flies had fed on blood, the majority of which was of mammalian origin. In the second series nearly 60 per cent contained the remains of a blood meal mostly from birds or reptiles.

Mechanical transmission of Sleeping Sickness by the tsetse fly, p. 498–501. Mechanical transmission can take place if the transference is instantaneous—that is by interrupted feeding—but not if an interval of time comes between the

feedings. Mechanical transmission plays a much smaller part, if any, in the spread of Sleeping Sickness than has been supposed.

In the first number of vol. 83 are two more papers on trypanosome diseases of domestic animals in Uganda.

Rats and Squirrels and Plague

Blue, Rupert. Rodents in relation to the transmission of bubonic plague. Pub. Health & Mar. Hospt. Ser. Bull., 30, 1910. Epidemilogical observations, ground squirrel infection, etc. References.

Converse, G. M. Intimate association of rats and ground squirrels. Pub. Health Rep. 25, no. 19, May 13, 1910. Finds rats and squirrels occupying the same holes and hiding under the same barns. Took rat fleas from squirrels.

King, W. G. Plague and the destruction of rats. Jour. Royal Inst. of Pub. Health, December, 1910. Discusses the recent outbreak in Suffolk and methods of fighting rats.

Lantz, D. E. Natural history of the rat. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. Classification, distribution, habits, etc.

McCoy, G. W. Plague among ground squirrels in America. Jour. of Hyg., December, 1910. A review and a good summing up of the plague situation in California.

McCoy, G. W. The evidence of plague infection among ground squirrels. Pub. Health Rept. 25, no. 2, January 14, 1910. Considers it conclusive that the disease among ground squirrels is caused by the same organism that causes plague among humans and rats.

McCoy, G. W. Antiplague measures in California. Pub. Health Rep. 25, no. 18, May 6, 1910. Tells of the work being done to exterminate rats and squirrels.

McCoy, G. W. Plague infection in Rats. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. Mode of examination, characteristics, lesions, artificial infection, etc. References.

McCoy, G. W. Plague infection in a bush rat. (*Neotoma fuscipes.*) Jour. Infec. Diseases, 7 (1910), no. 3, p. 368–373. This rat found to be infected.

McCoy, G. W. Bubonic plague in ground squirrels. N. Y. Med. Jour., October 1, 1910.

McCoy, G. W. and **Smith, F. C.** The susceptibility to plague of the prairie dog, the desert wood rat, and the rock squirrel. Jour. Infec. Diseases 7 (1910), no. 3, p. 374–376. Rock squirrels readily infected; evidence not sufficient in other cases, but they appear to be susceptible.

McLaughlin. The menace of plague in ground squirrels. Bull. Cal. St. Bd. Health, October, 1910. A review of the cases of plague due to ground squirrel infection. Points out the dangers from leaving infected squirrels in a locality.

Petrie, G. F. Rats and plague. Nature, November 3, 1910. A short article showing the relation of these.

Rucker, W. C. Note on plague infection in a wood rat (*Neotoma fuscipes*). Pub. Health Rep. 25, no. 1, January 7, 1910.

Rucker, W. C. Field operations against the squirrel plague in California. N. Y. Med. Jour., June 18, 1910.

Rucker, W. C. Rodent extermination. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. Trapping, poisoning, natural enemies, etc.

Simpson, F. Plague as a rural problem. Bull. Cal. St. Bd. Health, October, 1910. Points out that a region where infected squirrels occur is safe only when they are exterminated.

Stiles, C. W. and **Crane, C. G.** Internal parasites of rats and mice and their relation to diseases of man. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910.

Stiles, C. W. and **Hassall, A.** Compendium of animal parasites reported for rats and mice. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910.

Walker, E. A. Transmission of plague in the absence of rats and rat fleas. Indian Medical Gazett, March, 1910.

Reports on Plague Investigations in India. Issued by the Advisory Committee. Jour. of Hyg., November, 1910 (Fifth extra plague number). Among other articles the following refer especially to the relation of rats and fleas to the disease: "The experimental production of plague epidemics among animals." Further experiments which show that the plague spreads rapidly among rats when fleas are present. "Interim report of the Advisory Committee for plague investigations in India." A summary of the conclusions reached. They believe that "in the great majority of cases during an epidemic of plague man contracts the disease from plague-infected rats through the agency of plague-infected rat fleas."

The two articles on observations on rat and human plague in Belgium and Poona, especially the latter, show the very close relation of the prevalence of rat fleas to the number of cases of plague.

The rat and its relation to the public health. By various authors. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. (No number is is given on the bulletin but it is listed as no. 30 in the list of publications.) Contains articles in regard to the rat, its parasites and its relation to plague, etc. Some of these articles are listed in this and the following section of this list.

Plague in England. Ed. in Jour. Amer. Med. Assn., November 19, 1910. Refers to recent outbreak of plague in Suffolk, Eng.; four deaths; rats and hares found infected; immediate efforts to get rid of these and clean up; work done so quickly and quietly that the public hardly knew about it.

Fleas and Plague

Banks, N. Ectoparasites of fleas. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. Describes and gives tables for the identification of fleas, lice and mites.

Fox, Carroll. The flea and its relation to plague. Pub. Health & Mar. Hospt. Ser. Bull. 30, 1910. Among other things author discusses anatomy and habits of the fleas and gives descriptions of the common forms. References.

McCoy, G. W. A note on squirrel fleas as plague carriers. Pub. Health Repts. 25, no. 15, April 15, 1910. *Ceratopsyllus acutus*, the ground squirrel flea, transmitted plague from ground squirrels to guinea pigs and from squirrel to squirrel.

McCoy, G. W. Fleas as plague carriers between rats and ground squirrels. Pub. Health Repts. 25, no. 20, May 20, 1910. *C. acutus* can transmit plague from ground squirrels to white rats and *C. fasciatus* can transmit the disease from rats to ground squirrels.

McCoy, G. W. Fleas collected from squirrels from various parts of California. Pub. Health Repts. 25, no. 21, June 3, 1910. Records six species: *C. acutus; H. anomalus; Ct. musculi; A. gallinacea; H. affinis; Sp. inæqualis.*

Mitzmain, M. B. A parasitic and a predatory enemy of the flea. Pub. Health Repts. 25, no. 13, April 1, 1910. A new tyroglyphid mite, *Histiostoma tarsalis* found on *C. acutus*, *C. fasciatus*, and *L. cheopis*. A beetle (*Staphylinus* sp.) has been found to destroy rat and squirrel fleas; seems to be quite efficient.

Mitzmain, M. B. Notes on agents used for flea destruction. Pub. Health Repts. 25, no. 30, July 29, 1910. Water no value; glycerine no value; formalin, phenol, mercuric chloride, and trikresol in strengths used as disinfectants of little value. Powdered sulphur of no value; kerosene and miscible oil extremely efficient; the

fumigants bisulfide of carbon, hydrocyanic acid gas and sulphur dioxid are highly efficient.

Mitzmain, M. B. Some new facts on the bionomics of the California rodent fleas. Annals Ento. Soc. Amer. 3, p. 61–82, 1910. Relation to environment, locomotion, copulation, reaction to light, length of life, feeding, relation to plague.

Mitzmain, M. B. General observations on the bionomics of the rodent and human fleas. Pub. Health & Mar. Hospt. Ser. Bull. 38, 1910. Much the same data as presented in the last reference.

Rothschild, M. C. A synopsis of the fleas found on *Mus norwegicus*, *M. rattus alexanderinus*, and *M. musculis*. Bull. Ento. Research, Vol. 1, pt. 2, July, 1910.

Bedbugs

Girault, A. A. Preliminary studies on the biology of the bedbug (*Cimex lectularius*) 1. The effect of quantitatively controlled food supply on development. Jour. Eco. Biol., October, 1910. Reduced quantity of food did not affect reproduction or sex but lengthened the cycle indefinitely, reduced the size and increased the number of ecdyses.

Survival of bedbugs. A note in Jour. Amer. Med. Assn., June 11, 1910, refers to an experiment made by Dr. W. Hapgood in which he kept the bugs in a bottle without food for nearly six months.

Lice

Anderson, J. F. and **Goldberg, J.** On the infectivity of tabardillo or Mexican typhus for monkeys and studies on its mode of transmission. Pub. Health Repts. 25, no. 7, February 18, 1910. Believe that the body louse (*Pediculus vestimenti*) is the insect that transmits the disease.

Anderson, J. F. and **Goldberg, J.** Etiology of tabardillo or Mexican typhus; an experimental investigation. Jour. Med. Research, June, 1910. Disease not contagious, but authors believe that the body louse is responsible for the transmission.

Breinl, A. and **Hindle, E.** Life history of *Trypanosoma lewesi* in the rat louse. An. Trop. Med. & Parasit., March, 1910. Transmits this trypanosome from the infected to healthy rat by means of the rat flea.

Nicolle, C. Experimental research on exanthematous typhus. Ann. Inst. Pasteur. 24, no. 4, April, 1910. Demonstrates that the body louse that infects human beings transmits the disease.

Ricketts, H. T. and **Wilder, R. M.** The typhus fever of Mexico. Jour. Amer. Med. Assn., February 5, 1910. Think typhus not contagious, but transmitted by insects, probably lice.

Ricketts, H. T. and **Wilder, R. M.** The transmission of the typhus fever of Mexico (Tabardillo) by means of the louse (*Pediculus vestimenti.*) Jour. Amer. Med. Assn., April 16, 1910. Details of these experiments and summary of the results. The fever was transmitted from monkey to monkey and from man to the monkey by the louse.

Ricketts, H. T. and **Wilder, R. M.** The etiology of the typhus fever (Tabardillo) of Mexico; a further preliminary report. Jour. Amer. Med. Assn., April 23, 1910. Observations and theoretical considerations of the etiology of the organisms found in the blood.

Ricketts, H. T. and **Wilder, R. M.** Further investigations regarding the etiology of tabardillo, Mexican typhus fever. Jour. Amer. Med. Assn., July 23, 1910.

Sergent, E. and **Foley, H.** Investigations of recurrent fever and the method of its transmission in an Algerian epidemic. Ann. Inst. Pasteur, 24 (1910), no. 5, p. 337–373. *Pediculus vestimenti* may transmit the disease.

Recent studies on typhus fever. Ed. in Jour. Amer. Med. Assn., December 17, 1910. Gives the results of recent investigations.

Mites

Costa, E. Two important parasites of the skin. Jour. Cutaneous Diseases, January, 1910. *Dermatobia noxialis* found in tumefactions of the head. *Sarcopsylla penetrans* found in ulcerations in the regions of the nails of the feet.

Dahl, Fr. Mites in tumors. Centralbl. Bakt. Parsitenk., 53 (1910), p. 524-533. Describes a mite in tumors in human ovary. Discusses question whether this was simply a parasite in the tumors or a part of the cause of them.

Goldberg, Jos. The straw itch (*Dermatitis schambergi*); A disease new to American physicians. Pub. Health Repts., 25, no. 23, June 10, 1910. Described the disease and the mites that cause it. Figures and photographs.

Schamberg, J. T. Grain itch (*Acaro-dermatitis utricarioides*). Study of a new disease in this country. Jour. Cutaneous Diseases, February, 1910.

Webster, F. M. A predaceous and supposedly beneficial mite, *Pediculoides*, becomes noxious to man. Ann. Ento. Soc. Amer. 3, 1910, p. 15–39. (See also Bu. of Ento. Circular 118, 1910, for practically the same article.) Notes on mites attacking men in European countries. Probably *P. ventricosus* now *P. tritici*. Noted first in America as beneficial. Often attacking men handling grain or those sleeping on straw. Remedy: Thresh and burn straw in the field.

Ticks

Leishman, W. B. Mechanism of infection in tick fever and the hereditary transmission of *Spirochæta duttoni* in the tick. Lancet, January 1, 1910.

Stiles, C. W. The taxonomic value of the microscopic structure of the stigmal plates in the tick genus Dermacentor. Hygenic Laboratory, Bull. 62, 1910. Contains table for families and genera and description of species.

Theiler, A. Ticks and tick-borne diseases. Vet. Jour. 66 (1910) No. 416, p. 98–108. (See also Transvall Dept. Agric. Farmers Bull. 63.)

Miscellaneous Articles

Bruce, J. M. Recent progress in medical science. Med. Press & Circular, August 3, 1910.

Gunn, Herbert. The menace of tropical diseases to California. Cal. St. Bd. Health Bull., September, 1910. Relation of San Francisco to the orient and the various diseases that are to be guarded against.

Henshaw, H. W. Ground squirrels and spotted fever. Rept. of Bu. of Biological Survey for 1910. Tells of coöperation with Bu. of Ento. to study the relation of squirrels and ticks to this disease.

Hoff, J. R. Hookworm, malaria, yellow fever and their relation to the health of the American citizen. Woman's Med. Jour., June, 1910.

Marshall, H. T. Animal experimentation in relation to Protozoan tropical diseases. Jour. Amer. Med. Assn., April 23, 1910. Showing how various experiments have enabled investigators to make the recent wonderful advances in preventive medicine. Discusses amebic dysentry, Texas fever, malarial diseases, yellow fever, mosquitoes, sleeping sickness, etc.

McFarland, J. The rôle of Microzoa in the causation and transmission of diseases. Penn. Med. Jour., June, 1910.

Moulton, A. B. History of the progress made in the control of communicable diseases. Penn. Med. Jour., June, 1910.

Müller, R. Arthropods in transmission of disases. Munchener Medizinische Wochenschrift., November 15, 1910. List of insects, spiders, etc., with a discussion of the subject.

Nicolle, C. and **Manceaux, L.** Experimental reproduction of oriental sore in the dog. Compt. Rend. Acad. Sci. 150 (1910), no. 14, p. 889–891. Generally admitted that transmission of this disease takes place through the intermediation of some insect.

Schweitzer, H. Ehrlich's chemotherapy—a new science. Science, December 9, 1910. Tells of the methods of work and some of the results obtained by Erlich and his fellow workers. Refers particularly to trypanosomes and spirochæta and the chemicals used in combatting them.

Smith, A. J. Preventive measures against infectious diseases. Penn. Med. Jour., June, 1910.

Smith, A. J. Infantile paralysis. North American, October 13, 1910. Records discovery of a small Protozoan, resembling the sleeping sickness germ, in the blood of patients suffering from this disease and believes that they may be transmitted by insects.

Smith, J. B. Insects and Entomologists: their relation to the community at large. Pop. Sci. Mo., March and May, 1910. On pages 211 to 218 author discusses the relation of insects to the health of man and domestic animals.

Todd, J. L. Recent advances in our knowledge of tropical diseases. Bull. Johns Hopkins Hospt., July, 1910.

Townsend, E. J. Science and public service. Science, November 4, 1910. Among other things discusses what has been done, what is being done, and what should be done toward controlling infectious diseases.

Wellman, C. Tropical diseases observed in the vicinity of San Francisco. N. Y. Med. Jour., August 13, 1910.

The war against disease. Edinburgh Review, October, 1910. Discusses immunity in infectious diseases and reviews the development of the relation of insects to disease.

Quarantining the house against the diseases of summer. Ed. in World's Work, May, 1910.

INSECTS AND SPIDERS IN SPANISH MOSS

By Arthur H. Rosenfeld, *Tucuman, Argentine Republic*

Of the insect fauna of various sections of the United States, there is, perhaps, less known about that of the swamp than of any other group. This is natural when one considers the comparative isolation of average swamps, the difficulty of collecting in them during a large portion of the year, and the small economic importance to date of an investigation of swamp insects, *per se*. Nevertheless, future investigations of the insects inhabiting the swamps of various portions of the country will very likely throw important light upon the life histories, especially the hibernating habits, of several of our most important economic species.

In the winter of 1908–09, under the direction of Prof. Wilmon Newell, the writer examined a number of lots of the ordinary Spanish moss, *Tillandsia usneoides*, of the Louisiana swamps, in order to

ascertain the number of boll-weevils, *Anthonomus grandis* Boh., passing the winter in this excellent hibernating material. The results of these investigations, so far as the boll-weevil is concerned, have been published by Mr. Newell and Mr. Malcolm Dougherty in Circular 31 of the State Crop Pest Commission of Louisiana.[1] It occurred to the writer at the time that it would be of interest to collect all insects occurring in this moss, as well as all spiders, keeping an accurate record of the number of each species taken, as well as the amount of moss in each lot examined. Notes were also to be kept as to whether the insects found were alive or dead, but it was discovered that all insects taken were alive, this point illustrating, as Messrs. Newell and Dougherty have already pointed out, the excellence of the Spanish moss as hibernating quarters. From the number of insects and spiders taken from each lot of moss it was an easy matter to calculate the approximate number which would occur, in similar proportion, to a ton of the moss from the same location. While these calculations might not always be verified in actual practice, it is more than probable that the figures given represent fairly accurately the conditions as regards habitation of the various insects in the moss at different times, in terms of number of insects per ton. Of course this might not be the case where nests of ants were found in the rotten twigs among the moss, as in the case of *Cremastogaster lineolata* on December 23, 1909. In this case only the adult ants actually taken from the moss were counted.

There can be no doubt that Spanish moss is much sought after by a large number of insects as hibernating quarters, as is evidenced by the much greater number of insects taken from the moss during the winter months than during the warmer month of June. This will also be seen to hold good for the spiders.

Practically all insects taken were in the adult state, unless otherwise noted in the records. During the examinations of the moss, three or four Geometrid larvæ were taken, but were not bred to maturity.

The writer has pondered much over the best method of presenting this data. It was at first thought advisable to average the winter and summer lots of moss, thus reducing the report to two tables, but this was later considered inadvisable on account of the fact that a study of the increase or decrease of the number of several species for the different periods of the year might be of much interest. Hence it has at last been decided to publish the findings of each examination in full, even at the risk of making the tables of undue length. There is given below, therefore, in chronological order, the number of each species of insect and spider collected from each lot of moss, together with date of col-

[1] Page 168, Footnote.

lection and the weight of the moss examined, from which has been calculated the average number of insects per ton of moss, presuming that the moss examined gives a fair indication of the average inhabitants in that locality. The number of insects likely to inhabit a swamp during the winter, per acre, might also be approximated, but the trees vary so much in their load of the moss, and the number of trees bearing moss in the swamps is also so variable for different locations, that such a calculation would be extremely difficult.

All moss was collected in swamps in the vicinity of Mansura, in Avoyelles Parish, Louisiana, near the center of the state. The collections were made by Mr. Malcolm S. Dougherty, who was located at Mansura in charge of the hibernation experiments carried on by the Crop Pest Commission at that place.

In obtaining the weight of moss in each lot, the gross weight of the moss was first obtained before examining it for its insect contents. During this examination all twigs of any appreciable size were removed, and the weight of these later subtracted from the gross weight of the original lot. In this way the actual weight of the moss itself was gotten.

The moss was examined by placing it upon a table covered with white oilcloth or paper, and tearing it into fine shreds, holding the strands against the light of a window so that any insect in them would be readily seen, while those dropping upon the white tablecover could also be easily collected.

December 15, 1908

13.25 lbs. of *Tillandsia usneoides*

INSECTA.

Species	*No. found in lot*	*Approximate No. per ton*
Paromius longulus	94	14,100
Anthonomus suturalis	40	6,000
Anthonomus grandis	16	2,400
Nezara viridula	14	2,100
Lixus musculus	8	1,200
Bruchus cruentatus	6	900
Mantura floridana	6	900
Spermophagus robiniæ	5	750
Blattid, immature	4	600
Nysius californicus	4	600
Phymata erosa Linn., subsp. fasciata Gray	4	600
Disonycha pennsylvanica	3	450
Sinea spinipes	3	450
Largus succinctus	2	300
Phalacrus penicillatus	2	300
Psyllobora 22-punctata	2	300
Adalia oculata	1	150
Anthonomus scutellatus	1	150

Species	*No. found in lot*	*Approximate No. per ton*
Ceratoma trifurcata	1	150
Chlamys plicata	1	150
Cremastogaster lineolata	1	150
Cymodema exiguum	1	150
Epilachna borealis	1	150
Eudiagogus rosenschœldi	1	150
Hyperaspis signata	1	150
Leptostylus aculiferus	1	150
Pangeus bisulcatus (pupa)	1	150
Sinea sp.	1	150
Triphleps insidiosus	1	150
Tribolium ferrugineum	1	150
Typophorus canellus	1	150
Total Insects	228	34,200
ARACHNIDA		
Grammonota maculata	27	4,050
Anyphæna sp. (young)	4	600
Dendryphantes lineata	2	300
Dictyna foliacea	2	300
Phidippus sp. (young)	2	300
Zelotes sp. (young)	2	300
Herphyllus pallescens	1	150
Oxyopes salticus	1	150
Philodromus diversus	1	150
Runcinia aleatoria	1	150
Theridion spirale	1	150
Total Spiders	44	6,600

December 23, 1908

9.5 lbs. *Tillandsia usneoides.*

INSECTA

Cremastogaster lineolata	1,075	225,750
Paromius longulus	113	23,730
Anthonomus suturalis	79	16,590
Lixus musculus	18	3,780
Anthonomus grandis	15	3,150
Blattid, immature	13	2,730
Eudiagogus rosenschœldi	8	1,680
Mantura floridana	5	1,050
Psyllobora 22-punctata	4	840
Sinea spinipes	4	840
Bruchus cruentatus	3	630
Nezara viridula	3	630
Phalacrus penicillatus	3	630
Spermophagus robiniæ	3	630
Anthonomus suturalis, var.	2	420
Harmostes fraterculus	2	420
Nysius californicus	2	420
Phymata erosa Linn., subsp. fasciata Gray	2	420

Species	*No. found in lot*	*Approximate No. per ton*
Anthicus pubescens	1	210
Blattid, immature	1	210
Brochymena 4-pustulata	1	210
Caryoborus arthriticus	1	210
Cassida bivittata	1	210
Leptostylus aculiferus	1	210
Lobopoda erythrocnemus	1	210
Tribolium ferrugineum	1	210
Total Insects	1,362	286,020
ARACHNIDA		
Anyphæna fallens (young)	13	2,730
Grammonota maculata	12	2,520
Phidippus audax (young)	8	1,680
Philodromus diversus (young)	5	1,050
Mimetus interfector	3	630
Oxyopes scalaris (young)	3	630
Dendryphantes octavus	2	420
Epeira wittfeldæ (young)	2	420
Clubiona excepta (young)	1	210
Clubiona sp. (young)	1	210
Dictyna foliacea (young)	1	210
Epeira labyrinthea	1	210
Misumena sp. (young)	1	210
Theridium sp. (young)	1	210
Tmarsus caudatus	1	210
Total Spiders	55	11,550

January 6, 1909

14.75 lbs. *Tillandsia usneoides.*

INSECTA		
Cremastogaster lineolata	291	39,285
Paromius longulus	41	5,535
Blattid, immature	6	810
Anthonomus grandis	5	675
Bruchus cruentatus	3	405
Spermophagus robiniæ	3	405
Anthicus pubescens	2	270
Disonycha pennsylvanica	2	270
Phalacrus penicillatus	2	270
Acylamus ergoti	1	135
Agallia 4-punctata (larva)	1	135
Leptostylus aculiferus	1	135
Lixus musculus	1	135
Myochrous denticollis	1	135
Nysius californicus	1	135
Paria canella	1	135
Sinea spinipes	1	135
Tachinid, unidentified	1	135
Total Insects	364	49,140

ARACHNIDA

Species	No. found in lot	Approximate No. per ton
Grammonota maculata	12	1,620
Mimetus interfector	8	1,080
Philodromus diversus	5	675
Clubiona sp. (young)	4	540
Dendryphantes octavus	3	405
Philodromus sp. (young)	3	405
Clubiona excepta (young)	2	270
Liobunum sp. (young)	2	270
Misumena sp. (young)	2	270
Oxyopes scalaris (young)	2	270
Dolomedes sp. (young)	1	135
Epeira wittfeldæ (young)	1	135
Liobunum vittatum	1	135
Peckhamia picata	1	135
Pisaurinia undata (young)	1	135
Phidippus audax (young)	1	135
Sergiolus bicolor (young)	1	135
Tmeticus tridentatus	1	135
Total Spiders	51	6,885

January 11, 1909

20 lbs. *Tillandsia usneoides.*

INSECTA

Cremastogaster lineolata	96	9,600
Anthonomus suturalis	48	4,800
Paromius longulus	31	3,100
Anthonomus grandis	11	1,100
Eudiagogus rosenschœldi	6	600
Spermophagus robiniæ	5	500
Nysius californicus	4	400
Anthonomus albospilus	3	300
Nezara viridula	2	200
Adalia oculata	1	100
Apion n. sp.	1	100
Bruchus cruentatus	1	100
Cymodema exiguum	1	100
Cyphon obscurus	1	100
Leptoypha mutica	1	100
Zelus sp. (nymph)	1	100
Aræcerus fasciculatus	1	100
Total Insects	214	21,400

ARACHNIDA

Philodromus diversus	29	2,900
Anyphæna sp. (young)	14	1,400
Mimetus interfector	5	500
Oxyopes salticus	4	400
Epeira wittfeldæ	3	300
Liobunum sp. (young	3	300
Phidippus sp. (young)	3	300

Species	*No. found in lot*	*Approximate No. per ton*
Dendryphantes octavus	2	200
Gayenna sp. (young)	2	200
Grammonota maculata	2	200
Phidippus audax	2	200
Euryopsis funebris	1	100
Metacyrba tæniola	1	100
Philæus militaris	1	100
Thanatidius dubius	1	100
Tmarsus caudatus	1	100
Total Spiders	74	7,400

January 20, 1909

27 lbs. *Tillandsia usneoides.*

INSECTA

Paromius longulus	36	2,664
Anthonomus suturalis	26	1,924
Lixus musculus	6	444
Nysius californicus	4	296
Phalacrus penicellatus	4	296
Cremastogaster lineolata	3	222
Disonycha pennsylvanica	3	222
Unidentified Coleoptera	3	222
Nezara viridula	4	296
Harmostes fraterculus	2	148
Phymata erosa Linn., subsp. fasciata Gray	2	148
Psyllobora 22-punctata	2	148
Blattid, immature	1	74
Bruchus cruentatus	1	74
Calleida decora	1	74
Cycloneda munda	1	74
Cyphon obscurus	1	74
Dicerca obscura, var. lurida Fabr.	1	74
Eudiagogus rosenschœldi	1	74
Gryllid, immature	1	74
Sinea spinipes	1	74
Spermophagus robiniæ	1	74
Typophorus canellus	1	74
Total Insects	106	7,844

ARACHNIDA

Dendryphantes octavus	4	296
Grammonota maculata	3	222
Anyphæna sp. (young)	2	148
Phidippus audax	2	148
Epeira wittfeldæ (young)	1	74
Euryopsis funebris (young)	1	74
Philodromus diversus	1	74
Total Spiders	14	1,036

January 27, 1909

14.5 lbs. *Tillandsia usneoides.*

INSECTA

Species	*No. found in lot*	*Approximate No. per ton*
Anthonomus suturalis	89	12,282
Paromius longulus	74	10,212
Lixus musculus	11	1,518
Phalacrus penicellatus	9	1,242
Nysius californicus	7	966
Bruchus cruentatus	6	828
Blattid, immature	5	690
Anthonomus grandis	4	552
Phymata erosa Linn., subsp. fasciata Gray	4	552
Disonycha pennsylvanica	3	414
Brochymena arborea	2	276
Calandra oryzæ	2	276
Gryllid, immature	2	276
Nezara viridula	2	276
Psyllobora 22-punctata	2	276
Sinea spinipes	2	276
Spermophagus robiniæ	2	276
Acylamus ergoti	1	138
Anthonomus suturalis var	1	138
Ceutorhynchus sp.	1	138
Crepidodera rufipes	1	138
Cycloneda munda	1	138
Eudiagogus rosenschœldi	1	138
Haltica ignita	1	138
Tribolium ferrugineum	1	138
Typophorus canellus	1	138
Total Insects	235	32,430

ARACHNIDA

Phidippus audax	4	552
Grammonota maculata	3	414
Anyphæna sp. (young)	2	276
Dictyna sp. (young)	2	276
Oxyopes scalaris (young)	2	276
Philodromus diversus	2	276
Epeira wittfeldæ (young)	1	138
Herphyllus sp. (young)	1	138
Total Spiders	17	2,346

June 6, 1909

17.5 lbs. *Tillandsia usneoides.*

INSECTA

Anthonomus suturalis	3	342
Harmostes fraterculus	2	228
Hemiptera, unidentified	2	228
Mantura floridana	2	228
Diolcus chryssorrhœus	1	114

Species	*No. found in lot*	*Approximate No. per ton*
Spermophagus robiniæ	1	114
Total Insects	11	1,254
ARACHNIDA		
Grammonota maculata	3	342

June 15, 1909

16 lbs. *Tillandsia usneoides.*

INSECTA		
Diolcus chryssorhœus	9	1,125
Mantura floridana	4	500
Blattid, immature	2	250
Total Insects	15	1,875
ARACHNIDA		
Prosthesima n. sp. (young)	5	625

June 21, 1909

15.75 lbs. *Tillandsia usneoides.*

INSECTA		
Cremastogaster lineolata	9	1,143
Blatella dilatator	1	127
Nyctobates pennsylvanica	1	127
Total Insects	11	1,397

ARACHNIDA

None Taken

June 22, 1909

13 lbs. *Tillandsia usneoides.*

INSECTA		
Cremastogaster lineolata	6	924
Anthonomus suturalis	2	308
Calandra oryzæ	2	308
Mantura floridana	2	308
Catorama sp.	1	154
Paratenetus sp.	1	154
Solenopsis molesta	1	154
Total Insects	15	2,310
ARACHNIDA		
Grammonota maculata	1	154

June 23, 1909

21 lbs. *Tillandsia usneoides.*

INSECTA		
Mantura floridana	1	95
Philonthus hepaticus	1	95
Total Insects	2	190
ARACHNIDA		
Dendryphantes sp. (young)	1	95
Grammonota maculata	1	95
Prosthesima sp. (young)	1	95
Total Spiders	3	285

Remarks on Insects

Summarizing, we find that there are just 60 genera, representing 65 species of insects, if, for convenience, we count the variety of *Anthonomus suturalis*, taken on December 23d, as a species. That *Tillandsia usneoides* exercises a strong attraction as hibernating quarters for both insects and spiders is plainly shown by the large difference in number of species found in winter and summer lots of Spanish moss, and by the difference, even more striking, between the average number of insects or spiders per ton for the two periods. Of the 60 genera and 65 species of insects found, 53 and 58, respectively, occur in winter, while only 15 genera and species are found in summer. Seven genera and species were found in the June lots which did not occur in the winter lots, and these were found only in very small numbers. Nor is the summer population found in the different lots of moss so regular as that of the winter, only one species being found in four out of the five summer lots of moss, and only three species in as many as two lots. Eleven out of the fifteen species taken in June occur in but one collection of moss, while just one half of the fifty-eight species taken during the winter occur in two or more lots.

By number of insects per ton the average populations of the winter moss was 71,839, while the average of the summer lots is found to be but 1,405 insects per ton. In winter the proportion of spiders per ton to insects per ton is found to be as one to twelve, whereas in summer it is as one to five.

Of the insects taken from the six winter collections of moss

29 species occur in 1 lot
10 species occur in 2 lots
3 species occur in 3 lots
3 species occur in 4 lots
9 species occur in 5 lots
4 species occur in 6 lots

The most widely distributed insects taken during the winter, the number of lots of moss in which they were found, and the average number of insects per ton for the six winter lots, are given below.

Insect	*No. lots in which found*	*Av. No. per ton in 6 winter lots*
Cremastogaster lineolata	5	45,834
Paromius longulus	6	11,557
Anthonomus suturalis	5	6,933
Anthonomus grandis	5	1,313
Lixus musculus	5	1,179
Nezara viridula	5	584
Bruchus cruentatus	5	489
Nysius californicus	6	469

Insect	*No. lots in which found*	*Av. No. per ton in 6 winter lots*
Phalacrus penicellatus	5	456
Eudiagogus rosenschœldi	5	440
Spermophagus robiniæ	6	439
Sinea spinipes	5	296

In the winter lots *Cremastogaster lineolata* occurs at the head of the list of species collected, ranked by number per ton, three times. *Paromius longulus* occurs first twice, second three times and third once. In summer this species is not found at all. *Anthonomus suturalis* is found first once, second three times and third once. *Lixus musculus* occurs third twice, fourth once and fifth once. It will be observed that several species which are found in only five of the six winter collections of moss, occurred in these lots in such large numbers that, in average number per ton for the six lots, they stand higher than several species which were found in every lot collected.

Probably the most striking figure in this article is that of 1,313 boll-weevils per ton of moss as the average for the winter moss. Messrs. Newell and Dougherty have shown[2] that Spanish moss carried boll-weevils over the winter better than any other hibernating material, and an average number of over a thousand of these dangerous insects to each ton of moss in a central Louisiana swamp would certainly furnish a vast number of unwelcome guests to the nearby cotton-planters.

Of the insects found in the five lots of moss collected in June, we find only four occurring in more than one lot. These are

Insect	*No. lots in which found*	*Av. No. per ton in 5 summer lots*
Cremastogaster lineolata	2	413
Diolcus chryssorrheus	2	248
Mantura floridana	4	226
Anthonomus suturalis	2	130

It is significant that not one boll-weevil was found in summer.

Remarks on Spiders

Of spiders there are 28 genera, representing 40 species, 27 genera and 38 species occurring in the winter collections. In the summer only three genera and species are found, one genus, *Prosthesima*, not occurring in the winter, and the undetermined species of *Dendryphantes* is also lacking in the winter collections.

The average spider population of the six lots of moss collected during the cooler months is found to be 5,969 per ton, while for the June lots it falls to 281 per ton. Of the spiders taken from the six winter

[2] Circular 31, State Crop Pest Commission of Louisiana, 1909.

collections of moss, 21 species were found to occur in one lot only, 9 species in two lots, and 2 species each in three, four and all five lots.

The most common spiders taken during the winter, the number of lots of moss in which they were found and the average number of Arachnids per ton for the six winter lots, are given below.

Spider	*No. lots in which found*	*Av. No. per ton in 6 winter lots*
Grammonota maculata	6	1,504
Philodromus diversus	6	854
Anyphæna sp.	4	606
Anyphæna fallens	1	455
Phidippus audax	5	452
Mimetus interfector	3	368
Dendryphantes octavus	4	220
Oxyopes scalaris	3	196
Epeira wittfeldæ	5	178

Grammonota maculata and *Philodromus diversus* occur in all six winter lots, the former twice leading the list of spiders arranged by number per ton, and occurring second three times. It occurs tenth once.

The following three species were the only ones found in the June collections.

Spider	*No. lots in which found*	*Av. No. per ton in 5 summer lots*
Prosthesima n. sp.	2	144
Grammonota maculata	3	118
Dendryphantes sp.	1	19

Acknowledgments

The writer wishes to acknowledge his sincere thanks to Dr. L. O. Howard, for his kindness in having various insects identified, to Dr. W. M. Wheeler for the identification of most of the ants listed herein, to Prof. E. A. Schwartz for the identification of the larger number of the Coleoptera listed, to Prof. Otto Heidemann for the identification of most Hemiptera, to Prof. H. S. Barber for identifying *Scymnus collaris*, *Elaphidion parallelum*, *Haltica ignita* and *Nyctobates pennsylvanica*, to Prof. A. N. Caudell for identifying *Blatella dilatator*, and to Prof. Nathan Banks for the identification of all spiders.

ENTOMOLOGICAL MEETINGS, DECEMBER, 1911

The annual meeting of the American Association of Economic Entomologists, Entomological Society of America and Association of Official Horticultural Inspectors will be held during the Christmas holidays at Washington, D. C. Partial arrangements for the meetings are already under way and the attention of the entomologists is called to the matter at this time, so that they may know what progress is being made and plan in advance to attend.

The Entomological Society of America will meet on Tuesday and Wednesday, December 26 and 27. It is expected that a joint meeting will be held on one of these days with the American Association of Economic Entomologists; and if suitable arrangements can be made the first session of the meeting of the latter association will begin Wednesday.

The meetings will continue on Thursday, both morning and afternoon, and in the evening the opening session of the Association of Official Horticultural Inspectors will be held.

Friday morning the final session of the American Association of Economic Entomologists will be held and the rest of the day will be devoted to meetings of the Horticultural Inspectors.

Considerable difficulty has been experienced in arranging the meetings this year on account of the limited time which is available, and because of the fact that the meetings will probably be the largest and most representative of any that the associations have held.

Foreign members of the Association of Economic Entomologists are requested to forward at once the titles of any papers that they may wish to present at the meeting and the manuscript should be mailed so that it will be received not later than December 15, 1911.

Members wishing to recommend candidates for membership should apply to the undersigned as soon as possible for application blanks, so that they can be filled out and returned before the meeting in order that the membership committee may have time to act on as many applications as possible before the meeting.

A. F. Burgess, *Secretary, A. A. E. E.*

Through the recent unification of the South African Colonies, the entomological work which has heretofore been done by separate men working independently will now be consolidated into the Division of Entomology, Union Department of Agriculture, with headquarters at Pretoria. Mr. Charles P. Lounsbury, Government Entomologist, Cape of Good Hope, has been made Chief of the Division.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The annual midsummer dominance of the house fly is at hand, together with a large crop of newspaper paragraphs and popular articles in regard to the situation. It is evident that correct information is much more widely distributed than in earlier years though there are still occasions where the guiding hand of the entomologist might have bettered matters. The present is an excellent time to create a favorable sentiment for coöperation in communities for the purpose of controlling flies, even though nothing more than a start be made this season.

The general interest in insects as disease carriers is strikingly shown in the ten-page bibliography appearing elsewhere in this issue and listing only the more important contributions during 1910 to this phase of economic entomology. Reference to the list shows that the results of these recent investigations are being incorporated in various text books and general works. There is also a perceptible widening in the sphere of study. Mosquitoes and flies, with special reference to their part in the dissemination of malaria, yellow fever and typhoid fever, still receive attention, but in addition there is a voluminous literature dealing with the relation of flies to other diseases, especially sleeping sickness. Plague and its connection with rats, squirrels and fleas has been a subject of prime importance on the Pacific coast. The part body parasites may have in the spread of disease has aroused active interest on the part of several investigators. Only recently a painful cutaneous eruption has been definitely associated with a predaceous and hitherto supposedly entirely beneficial mite.

The recent action of the George Washington University in conferring the honorary degree of Doctor of Medicine upon an entomologist, for "distinguished services to science in relation to preventive medicine," is gratifying testimony to the position entomological knowledge

is taking in the estimation of our progressive medical men. It is a well earned reputation. The entomologist, the moment there seemed to be a vital connection between infectious diseases and insects, undertook systematic and biological investigations which soon resulted in opening up new realms of thought and demonstrated the economic importance of the well-known, yet up to recently, almost unknown house fly. This insect—formerly ignored, accepted as an inevitable associate of man, considered hardly worthy of jocose treatment—has now risen to the dignity of an important insect. It is the subject of paragraphs innumerable, and now our learned associate in Washington has demonstrated the possibility of writing a popular and interesting book on this hitherto much despised insect. This represents only one phase of the relation of entomology to medicine. The successful campaigns waged against malaria in various parts of the world depend for success very largely upon our systematic and biological knowledge of certain mosquitoes. The deadly yellow fever is controlled with the subjection of a different mosquito, and this is another signal triumph of practical or economic entomology in the field of medicine. The connection of the wide-spread African blight known as sleeping sickness, with the malignant Tsetse fly is an additional instance where entomology and medicine have coöperated. No word is necessary to demonstrate the importance of biological investigations of these disease carriers. Many valuable facts have been learned respecting these forms in recent years and capable investigators are searching for additional information which will be of value in the campaign against disease-carrying insects.

The scientific meetings shortly to be held at Washington will rank among the largest and most representative of such gatherings. There will be an excellent opportunity on the part of all participants to exercise commendable self-restraint. The more papers and discussions, especially if meaty and to the point (and no others should be submitted) the better. Let us cultivate the fine art of preparing papers embodying all the essentials yet praiseworthy because of the omission of prolix and often irrelevant details. It is well known that many extremely important points are brought out in discussions. These latter can occur only, especially at this meeting, if each man limits himself rigidly to the essentials. All presenting papers should remember that they are talking to an unrivaled assemblage of experts and gauge their statements accordingly.

Reviews

The House Fly—Disease Carrier, an Account of Its Dangerous Activities and of the Means of Destroying it, by L. O. Howard. New York. Frederick A. Stokes Co., 1911, pp. i–xix, 1–312.

This admirable work discusses all phases of the fly problem in a non-technical manner and yet with such scientific accuracy that the economic entomologist will find therein much of value, especially as it summarizes the latest developments in solving the fly problem. Some sixty pages are devoted to a discussion of the zoölogical position of the insect, its life history and habits. There are in this chapter a number of extremely valuable suggestions for future investigations. Natural enemies of the fly are considered in some detail as well as the insect's place in the dissemination of a number of diseases. The fifty odd pages dealing with remedial and preventive measures discuss fully the various problems involved, considerable attention being given to the coöperation necessary in cities and villages. The final chapter comprises accounts of a number of species occurring in houses. The bibliographical list will prove of much service to those interested in the original sources of information. The appendices contain much valuable information in regard to flies occurring in manure and kitchens, the regulations of the health department of the District of Columbia relating to house flies and methods of constructing and maintaining sanitary privies. The volume as a whole is a distinct addition to our knowledge concerning this most important insect, and the author, in the preparation thereof, has rendered a material service, not only to the general public but to all workers interested in this line of effort. The illustrations are excellent and the letter press admirable.

Scientific Notes

Rose leaf hopper (*Typhlocyba rosæ* Linn). An examination of available literature shows that this insect is supposed to hibernate in the adult stage, yet an investigation of rose bushes in the fall, during winter and in early spring, failed to reveal any such adults in the vicinity of the bushes. Some shoots were brought in in early spring before the foliage had started, and the eggs were found deposited singly just under the new bark. Their location is indicated by an almost imperceptible, oval elevation in the bark, about 1 mm. long and presenting a slight greenish or yellowish discoloration, occasionally accompanied by increased transparency, due to the egg beneath. There is at one end of the elevation a very slight scar made at the time the egg is deposited. This latter is quite different from the elongate lenticel seen upon the wood. It is comparatively easy to expose the eggs by simply rupturing the bark on either side with a needle and raising it. The egg has a length of .7 mm., a diameter of .2 mm. It is narrowly oval, the anterior extremity broadly rounded, while near the posterior third there is a slight curve, the posterior extremity being narrowly rounded. It is semi-transparent. April 17 material taken in the field contained a semi-transparent, yellowish embryo, with a length about one third that of the egg, and showing an indistinct segmentation. May 14 nymphs were numerous on the lower leaves especially, their presence being indicated by the rather characteristic white spots along the veins. The abundant growth above these affected leaves obscures, in large measure, the early signs of this insect. The injury becomes more

marked on the lower leaves as the season advances. May 25 the nymphs were about three fourths grown. The first adults were observed June 3.

Miastor. Recent collecting has resulted in finding the larvæ in the decaying bark of maple, chestnut, oak, birch, beech and hickory, rearings confirming the identity in all cases except one. In addition, a species of Oligarces has been obtained from decaying elm bark. The vitality of Miastor larvæ is amazing. Some have lived and propagated for nearly six months in a small piece of decaying wood lightly clamped to a microscopic slide, while individual larvæ were kept in sealed water cells for about four weeks. The latter were subjected to daily examinations with a microscope, and in spite of the adverse conditions, the vital processes continued and the embryos developed though slowly. We were fortunate, in the case of two larvæ, to witness the development of the egg in the ovary, its separation by fission and the growth of the embryo to an individual ready to escape from the mother larva. The development of the embryo is at the expense of the mother, pulsations continuing in the latter so long as a fragment of the dorsal vessel remains. In one specimen observed, the dorsal vessel was ruptured in the vicinity of the sixth body segment, and the free anterior portion continued violent pulsations and irregular wrigglings till the next day, at which time the movements were much slower and the following day had disappeared entirely. An indefinite number of pedogenetic generations succeed each other. The appearance of the two sexes is presaged by the larvæ developing distinct breastbones, soon followed by a change to the prepupa. This stage has a duration of two to three days and is characterized by a marked swelling and transparent condition of the anterior body segments of the larva, the portion occupied by the pupal head and thoracic region. The duration of the pupal stage is from three to six days, numerous adults appearing within a few days and emerging from their habitat in the late morning hours, approximately from 9 a. m. to noon. Miastor larvæ are actively preyed upon by the pinkish larvæ of Lestodiplosis and also the larger predaceous maggots of *Lonchæa polita* Loew and a species of *Medeterus*. It not infrequently happens in nature that an abundance of the larvæ of these two latter is about the only available evidence of the earlier occurrence of Miastor larvæ, though exploration of the bark beyond where these predaceous enemies occur, frequently results in finding colonies of Miastor.

E. P. Felt

A Correction. In my paper, "Further Notes on the Aphididæ Collected in the Vicinity of Stanford University," Journal of Economic Entomology, August, 1910, p. 372, I described an aphid of the genus *Pemphigus* on the California buttercup (*Ranunculus californicus*) giving it the name of *Pemphigus ranunculi* sp. nov. According to the new rules in Zoölogical nomenclature this specific name does not hold good since Kaltenbach described an European species under the same name (Monog. Pflz. 1843), although the latter has been lately regarded as a synonym for *Pemphigus affinis*. Accordingly I propose the name of *Pemphigus californicus* Davidson. Mr. E. O. Essig has lately sent me examples of this insect labeled "on *Ranunculus californicus* Benth., Nordhoff, Cal."

W. M. Davidson

Current Notes

Conducted by the Associate Editor

At the recent session of the Nebraska legislature a bill (H. R. 576) was passed making important changes in the administration of the office of State Entomologist. Previously, the Professor of Entomology of the University of Nebraska (Prof. L. Bruner) was authorized by law to act as state entomologist, and the legislature made appropriations from the general fund of the state to cover the necessary expenses for carrying on entomological work, which were expended under the direct control and supervision of the acting state entomologist. Under the new arrangement, the control of the office is vested in the Board of Regents of the University, who are empowered to designate one of the teaching staff of the University to act as state entomologist, and to administer and expend the funds appropriated for entomological work from the general fund of the state as they do university funds generally. The Board of Regents are also empowered to make, from time to time, such rules and regulations governing the duty of the entomologist to the people of the state as it deems wise, and are required to see that such services shall not interfere with the prime duties of the entomologist as a teacher and investigator. The legislature appropriated a sum of $5,000.00 for the biennium to be expended in the investigation and control of the insect pests of the state. Prof. Lawrence Bruner was subsequently designated by the board to be state entomologist. The complete working staff of the office at the present time is as follows: Prof. L. Bruner, entomologist; Prof. Myron H. Swenk, assistant entomologist; Mr. J. T. Zimmer, field expert, and Messrs. R. W. Dawson and L. M. Gates, laboratory and field assistants. The work of the current year consists largely of an intensive study of grasshopper control measures while special investigations of the pine-tip moth, wheat-root aphid, melon aphis and other important insect pests are also in progress.

Mr. W. W. Froggatt, government entomologist of New South Wales, has been appointed Lecturer in Economic Entomology to the Chair of Agriculture of the Sydney University. This appointment is for a period of seven years, and carries a salary of five hundred dollars. The work will be carried out in conjunction with Mr. Froggatt's present official work, and the appointment is the first of its kind in Australia. Mr. Froggatt has also been elected president of the Linnæan Society of New South Wales, the leading scientific society in Australia. Since the death of its founder, Sir William Macleay, nearly twenty years ago, no entomologist has until now held the office of president.

At Clemson College, S. C., the entomological work in the college and station have been combined, and A. F. Conradi has been made professor of entomology in the college in addition to his work as station entomologist. W. P. Gee has been appointed assistant professor of entomology in the college.

According to *Science*, William B. Herms, assistant in entomology at the University of California, is on a visit to Europe, where during the summer he expects to visit the principal parasitological laboratories of England, France, Germany and Italy. He will also represent the University of California as a delegate to the International Hygiene Exhibit at Dresden.

In June, 1911, Mr. Paul Hayhurst was made professor of entomology at the University of Arkansas, Fayetteville, Ark., and also entomologist of the station, and state nursery inspector. Mr. George G. Becker has been appointed assistant.

Purdue University has recently established a new department of entomology, with Prof. James Troop as its head. Professor Troop has taught both horticulture and entomology for twenty-seven years. Now he will give his entire time to entomology.

P. H. Hertzog of Bucknell College, formerly of the Laboratory of Economic Zoölogy at Harrisburg, Pa., is assistant for the summer in the Bureau of Entomology, department of cereal and forage insect investigations, under Prof. F. M. Webster.

According to *Science*, Dr. Robert Newstead, lecturer in economic entomology and parasitology in the Liverpool School of Tropical Medicine, has been appointed to the newly established Dutton Memorial Chair of Entomology in the University of Liverpool.

F. C. Craighead of State College, Pennsylvania, is now connected with the Bureau of Entomology, in the department of forest insect investigations, under Dr. A. D. Hopkins.

The legislature of Oregon has made an appropriation of $25,000 annually to the Experiment Station, $15,000 of which is to be used in the investigation of crop and fruit pests and other horticultural problems.

Prof. L. Bruner, State Entomologist of Nebraska, is spending the summer on his farm near Worland, Wyo. During his absence the entomological investigations in Nebraska are being directed by his assistant, Prof. Myron H. Swenk. At a recent meeting of the Board of Regents of the University, Professor Swenk was promoted to the rank of associate professor.

Dr. L. O. Howard was recently elected a member of the American Philosophical Society.

Dr. E. W. Berger, entomologist of the Florida Experiment Station, has resigned to accept the position of inspector of nursery stock for the state of Florida. Mr. Berger began his new duties July 1st with his office in the Experiment Station Building, Gainesville, Fla.

Mr. U. C. Loftin, laboratory assistant to the entomologist of the Florida Agricultural Station, has resigned to teach agriculture in a high school in Texas.

Mr. F. C. Pratt died at Dallas, Tex., on May 27, 1911. He was one of the oldest employees of the Bureau of Entomology. His service began in 1892 and extended over a period of nineteen years. An Englishman by birth, Mr. Pratt's early entomological training was obtained in the British Museum and in the Rothchild Museum at Tring. For the past five years he was connected with the Southern Field Crop Insect Investigation of the Bureau of Entomology. A more extended notice will appear in the next issue of the Proceedings of the Entomological Society of Washington.

Mr. D. W. Coquillett, widely known as the leading American Dipterist, died July 8, 1911, at Atlantic City, N. J., at the age of fifty-four.

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FORMALIN FOR POISONING HOUSE FLIES PROVES VERY ATTRACTIVE WHEN USED WITH SWEET MILK

By R. I. SMITH, *North Carolina Experiment Station*

During the early part of June, 1911, while attempting to reduce the flies at the horse barns and dairy of the North Carolina Agricultural and Mechanical College, I attempted to poison them with formalin, and secured rather remarkable results. House flies (*Musca domestica*) were very numerous when the work was commenced, owing to the fact that the manure had been allowed to accumulate for six or eight weeks. In the milk room (which was screened shortly afterward) the flies covered the walls and ceiling, and the straining cloth at milking time was actually black with flies. In justice to the College and the writer, allow me to explain that this disgraceful condition was soon remedied and that during the past three months the dairy has been remarkably free from flies.

My previous experience with formalin for poisoning flies had been confined to using it a few times in the laboratory in the proportion of one part to twenty parts of sweetened water, but realizing that the poison must be made attractive if used successfully in the milk room of a dairy, I decided to try it with milk instead of water.

My first experiment proved successful. This was the addition of one ounce of 40 per cent formalin to sixteen ounces of fresh milk. This mixture was placed in four shallow tin plates and set on the floor of the milk room about 3 o'clock one afternoon. The flies commenced to feed and die within a few minutes, and continued to die rapidly even while the evening's milk was being brought in and strained. These plates of poison were left over night and the milkers advised me that the flies were feeding greedily the next morning soon

after daylight. The dead flies, swept up about eight A. M., measured about one pint, representing fully 5,000 flies.

This experiment was repeated for three successive days and about one pint of dead flies were swept up every morning. In addition to the flies actually secured many dropped dead outside the windows.

My next experiment was to use a mixture of half milk and half water instead of whole milk. Formalin was added in the same proportion, one ounce to sixteen ounces of diluted milk. This proved to attract the flies as well as whole milk.

Several variations in the proportion of formalin and milk were tested, but my conclusion is that the use of one ounce to sixteen is most effective. The following method of stating the formula has been used for newspaper articles, in order that every housekeeper can prepare it easily:

"One ounce (two tablespoonfuls) of 40 per cent formalin; sixteen ounces (one pint) of equal parts milk and water.

"This mixture should be exposed in shallow plates and by putting a piece of bread in the middle of the plate, it furnishes more space for the flies to alight and feed and in that way serves to attract a greater number of them. Whole milk can be used, but the diluted milk seems to be just as successful. The formalin can be purchased for fifty cents a pint."

A very conclusive test of the efficiency of the above formalin mixture was made in a large calf barn where flies were extremely numerous. Six plates of the mixture were placed in the passage way between the stalls. This passage way is about six feet wide and thirty feet long. The poison mixture was exposed at 12 o'clock, noon, and left until 8 o'clock the next morning. The dead flies when swept up measured three quarts, and certainly one half as many died in the stalls on each side. I estimated that we killed between forty and fifty thousand flies in twenty hours by this experiment.

At the writer's suggestion many housekeepers in Raleigh and West Raleigh have used the formalin as recommended above, and several have reported the killing of flies by the pint and quart. A gentleman in charge of a farm where a large horse barn is maintained tells me that he poisoned a gallon of flies the first day he tried the mixture. This statement was vouched for by other witnesses in whom I have perfect confidence.

A good place to expose the formalin mixture is on the front and back porches, where flies are frequently numerous, and waiting to enter when the doors are opened. I know of several people who have used it successfully in this manner.

The use of the formalin-milk mixture in dwelling houses has not

proved so successful, except in unscreened kitchens or dining rooms.

This poison was tested in the large College mess-hall—where over four hundred students can be seated—resulting in practically cleaning up all the flies in two days. Previous to that time the steward had been using tanglefoot fly paper, often having as many as thirty sheets exposed. Fully that number were present when the formalin was used, but in spite of them the flies were numerous.

Entomologists are aware that formalin as a fly poison has been condemned many times, especially so last year, as I am advised by Edward Hatch, Jr., chairman of the Fly-Fighting Committee of the American Civic Association. It is partly for this reason that I have taken so much space in recording my results with formalin.

West Raleigh, N. C., September 7, 1911,

THE USE OF SWEETENED POISONS AGAINST THE GRAPE ROOT-WORM AND THE ROSE CHAFER

By F. Z. Hartzell

Entomological research at the Vineyard Laboratory has been confined largely to exhaustive studies of a few of the more important insects infesting the vineyards in Chautuaqua county, N Y. Two species have been responsible for much loss during the last decade: the grape root-worm (*Fidia viticida* Walsh) and the Rose Chafer (*Macrodactylus subspinosus* Fabr.) Both of these insects have been studied extensively by a number of entomologists in the various grape regions of the U. S. and our literature details the several remedial measures that have been used.

The author reported experiments conducted against these pests during 1909–10.[1] During the present season these have been continued and additional data secured which confirms his first claims as well as showing that even better results may be secured by the use of two gallons of molasses where one was used before.

Grape Root-worm. This is the most important insect of the vineyards on the south shore of Lake Erie where it has been known since 1893 when Prof. F. M. Webster gave the first account of its destructiveness and later published its life history. Since then it has been studied by others especially by Prof. Slingerland, Dr. Felt, Messrs. Fred Johnson and A. G. Hammar, so that we have in addition to its life history, much data regarding the periods of abundance and

[1] A Preliminary Report on Grape Insect, F. Z. Hartzell, Bull. 331, N. Y. Agr. Expt. Station, Geneva, N. Y.

scarcity of the insect in the same locality for a period of over ten years.

The remedy used has been arsenate of lead and this has been combined with the Bordeaux mixture. Its use has given good results in the hands of most experimenters but there have been failures when the work has been done thoroughly and many of the vineyardists have had similar experiences. At first we were inclined to regard such failures as due to careless and indifferent spraying, believing that the men conducting the spraying either did not apply it thoroughly or applied it at the wrong time, but our experience in connection with a series of coöperative experiments where the work of spraying was carefully watched and which did not give the expected results, indicated that some other factor entered into the problem. As it was believed that the beetles migrated from sprayed to unsprayed vines and since no dead beetles could be found under such sprayed vines, we made a careful study of the failure to control the beetles by the ordinary spray.

About an acre of vineyard was sprayed a second time the same day, thus using 200 gallons to the acre and as the vines were not very luxuriant, almost every leaf was covered with the Bordeaux mixture and arsenate of lead. Sheets placed under the vines had no dead beetles the next morning but the vines were free from beetles where the day before were thousands. Another acre about an eighth of a mile away was sprayed with a mixture of six pounds of arsenate of lead and one gallon of molasses to each 100 gallons of water. The vines were sprayed once, using about 100 gallons of material to the acre. All the foliage was not covered as it is next to impossible to do so with stationary nozzles at one spraying. Sheets placed under the vines had a number of dead beetles the following morning and a few beetles were still feeding on the vines. This plainly was an example, on the one hand, of migration because of a distaste of the material used, and, on the other hand, a feeding on the poison due to its pleasant taste.

With this clue, during the present season, a large number of brands of arsenate of lead have been used in cage experiments in which both sprayed and unsprayed leaves were in the same cage. With every brand the beetles preferred to feed on the unsprayed foliage showing very plainly that they dislike arsenate of lead. Other cages where the poison was added to either glucose or molasses showed the beetles feeding greedily on the sweet material. This was also noticeable in the field experiments where the beetles were observed passing to those parts of the vine that were covered with the sweetened poison, thus plainly showing their tastes. Moreover, vineyards seriously infested

with beetles this summer were sprayed with the same material and the disappearance of the beetles occurred in from a few days to a week. The finding of their dead bodies told the story of their departure.

Let us now return to our failures and seek an interpretation. The portions of the vineyards where the use of Bordeaux and arsenate of lead gave poor results were composed of vines having a luxuriant growth of foliage so that the spraying of these vines, using four fixed nozzles on a side, applying 100 gallons per acre, showed between 80 and 90 per cent of the foliage covered with the spray. If any of the beetles migrated to other vines we were not aware of the fact but there were many of them feeding on the 10 per cent of foliage that remained uncovered.

At the time these insects are feeding on the foliage, the growth of the vines is very rapid so new leaves are developing and by two days after spraying there is fresh unsprayed foliage for them to feast upon. Thus they feed unmolested and in time lay their eggs thereby accomplishing the very thing we are aiming to prevent.

We believe that either the inability to cover the foliage especially where dense, with the present use of fixed nozzles or the use of improper nozzles accounts for all the failures to control the grape root worm by means of the Bordeaux mixture and arsenate of lead. Experiments show that the use of the molasses-arsenate of lead mixture gives superior results, since the inability to cover all the foliage is balanced by the habit of the beetles seeking the sweet and also the insects are killed instead of being driven to other vines as appears to be the case with other mixtures.

The formula we recommend is six pounds of arsenate of lead, two gallons of molasses and 100 gallons of water.

Rose Chafer. The behavior of this insect towards arsenate of lead alone or with Bordeaux mixture is similar to that of the root worm. This has been determined by cage experiments as well as field observations. The reasons that we find so many failures in attempts to control this pest are as follows: (1) the beetles come in enormous numbers, every blossom cluster having from one to a dozen feeding on it; (2) The first feeding on grape is confined largely to the blossoms and blossom buds. The attempts to spray the vines with fixed nozzles, often results in covering the foliage but not covering the blossoms and buds, so the beetles are not inconvenienced in feeding on these delicate structures. A single beetle can destroy a number of the flowers before eating sufficient poison to kill it, even though these parts should have some poison on them. Thus the crop of fruit will often be ruined in a few days and the migration of the insects to other plants will be of

little value to the vineyardist. Very thorough spraying will sometime cause them to migrate and thus save the crop.

Our experiments were first conducted with the aim of finding a more active poison than arsenate of lead but we learned from cage experiments that the rapidity with which the insects die shows little in favor of the theory that the molasses or glucose increases the action of the arsenate of lead, but we find that the beetles relish the sweet material so we have the same explanation for its effectiveness as with the grape root worm. This alone we believe is the cause of the great difference in efficiency between the two sprays. Field experiments conducted this season gave practically the same results as reported for 1910 in Bulletin No. 331 of the N. Y. Agricultural Experiment Station. We also proved that the use of two gallons of molasses is effective and less expensive than 25 lbs. glucose per 100 gallons of material.

The use of molasses with arsenate of lead in Bordeaux mixture gave the same results as when the arsenate of lead and Bordeaux were used alone. This we believe is due to the excess lime and copper hydrate counteracting the sweetness of the molasses. We regret that this is a fact as it leaves us without a fungicide unless we make extra sprayings after the rose chafer and grape root worm have been disposed of.

CALIFORNIA REDWOOD ATTACKED BY TERMES LUCIFUGUS ROSSI[1]

By William B. Parker, *Bureau Entomology, U. S. Department of Agriculture*

During January, 1911, while investigating the work of *Termes lucifugus* upon the roots of the hop vine, near Sacramento, California, the writer observed that many California redwood string pegs, used in stringing the yards, were infested by white ants. Many were hollowed out in the manner characteristic of the work of termites, only the outside shell remaining. Others were attacked on the outside, the grooves being covered with sand cemented together. Pegs which had remained in the ground over two seasons were found to be mere shells and full of termites. Last year's pegs although badly damaged were not in such bad condition.

White ants were also found in the trellis poles, in some cases the portion of the pole under ground being entirely destroyed. Such poles were supported by the trellis wire attached to the tops. They were of little value in supporting a crop of hops. Where moisture had risen in the wood above the surface of the ground, the termites followed

[1] Published by permission of the Chief of the Bureau.

it, in some cases working from three inches to a foot up the pole in the dry wood. Termites were also found in redwood fence posts and in the redwood sills of a small building standing in the infested yard. The termites were first noticed by the hop growers in April, 1908. The yard in which they first appeared was overflowed by the American river in January of the same year and when the water retreated, a large amount of driftwood was left on the ground. Since the termites were not seen before this time, it seems quite probable that they came in with the logs and when the water retreated, established themselves in the hop yard.

The California redwood has heretofore been considered quite immune to attack by the white ant. Dr. L. O. Howard in Bulletin No. 30 of the Bureau of Entomology U. S. Department of Agriculture under the title "On the Alleged Immunity of the California Redwood to Attack by Termites" quotes from a letter received from Mr. J. E. Norton of Manila. The experiments described in Mr. Norton's letter, indicate that the California redwood is immune to attack by white ants. Mention is made regarding the possible immunity of California redwood in Circular No. 50 of the Bureau of Entomology by Mr. C. L. Marlatt as follows: "Capt. Geo. P. Ahearn, U. S. Army, reports that California redwood has been used for more than twenty-five years in the Philippines, and has never been known to be injured by white ants." The work of these insects upon the string pegs and trellis poles in the hop yards near Sacramento, however, proves that, under some circumstances at least, this wood is subject to attack by *Termes lucifugus*.

NOTES ON TWO IMPORTANT PARASITES OF ECONOMIC INSECTS

By A. B. Gahan

The following incomplete notes are taken from the records of the Entomological Department of the Maryland Experiment Station, and are submitted in the hope that they will prove of interest to economic entomologists.

Telenomus quaintancei Gir.

This parasite in the eggs of the peach tree borer, *Sanninoidea exitiosa*, described by Girault in 1906 (*Psyche* XIII, p. 63), was reared by the writer September 9, 1911, from eggs collected at College Park, Md. Mr. E. N. Cory on August 21 brought to me a single female specimen which he had observed crawling over a cluster of borer eggs on a peach leaf. The mass of eggs was also secured and placed in a vial for

observation. September 9, five specimens of the same parasite emerged in the vial, indicating that the development from egg to adult in this parasite covers a period of about nineteen days. While not conclusive, it is reasonable to suppose that the bred specimens are the product of eggs laid by the above mentioned female shortly before she was captured. This is of importance, as showing the opportunity for a number of generations of the parasite during the normal egg-laying period of the moth.

Aphidius nigripes Ashm.

During the spring of 1909 there was a noticeable abundance of the European grain louse (*Macrosiphum granaria*) on the wheat, oats, barley and rye fields of the Experiment Station farm. On May 7, it was noticed that Aphidiine parasites were abundant in the fields and they continued so until the time of harvest. Parasitized aphides were collected and parasites reared in considerable numbers. The majority of them proved to be the above named species, although another species identified as *Aphidius rosæ* Haliday, a common parasite of the rose aphis, was also present in considerable numbers.

In the early spring of 1910, further observations were obtained on the parasite. Specimens of *Aphidius* were first collected with a net in the rye fields on March 21, when two specimens were taken. On March 30 the parasite was much more abundant, fifty specimens being taken on this date. Of this number all except three were males. No aphides were discovered at this time on the rye, although some were doubtless present as they later became quite numerous. Search was made for parasitized aphid bodies which might have served as the over-wintering cocoons of the parasites, but none were located. It is not intended to imply by this that the parasites wintered as adults. The contrary is very probably the case, since the only species of Aphidiinæ whose hibernation have been observed winter as larvæ in the swollen bodies of their host. The predominance of males at this time and the absence of any parasitized aphides on the grain would seem to indicate that the specimens collected were those of the first over-wintering generation.

Another collection of parasites was made on April 11, and all were found to be males. The parasite was apparently less abundant than on the earlier date. A few aphides were found on this date but none showing parasitism. The latter part of March had been warm and balmy, accounting for the early abundance of the parasite. This was followed by much cold, wet weather in April, making it certain that many of the parasites must have perished.

Several subsequent observations taken during April and May showed that aphides were increasing in abundance and that the para-

site was present in small numbers, but it was not until May 25 that evidence was found of the advent of a new generation of the parasite. On this date several swollen bodies of lice were found and from two of these the parasites had already emerged. May 27 I was able to collect a considerable number of pupating parasites, and by the thirtieth, the dead, swollen bodies of the parasitized lice were very abundant on the leaves, stems and heads of both rye and oats. It was also noticeable that many of the large living aphides were of a very much darker color than normal and upon dissection these were invariably found to contain the nearly full grown larva of the parasite. It was also noted that these dark colored individuals were rarely surrounded with colonies of newly born aphides, as was the case with normal specimens, thus showing that reproduction had been stopped some time before the death of the louse, a fact having considerable bearing on the efficiency of the parasite, as previously pointed out by Professor Webster in his account of the *Lysiphlebus* parasite of *Toxoptera graminum*.

An attempt to determine the length of the life cycle of the parasite was unsuccessful, owing to the fact that it was carried out in an ordinary glass-covered insectary, the temperature of which proved to be too high for their development. Observations, however, warrant the belief that the normal development in June covers a period of from fourteen to sixteen days. The period from the death of the host until emergence of the parasite is usually about five days.

The parasites continued to increase in abundance until the grain was cut, by which time the majority of the aphides in the fields were parasitized. There can be but little doubt that had it not been for the presence of this parasite, the damage to the grain on the Experiment Station farm would have been severe in both seasons. As it was, little damage was done.

NOTES ON THE LIFE HISTORY OF THE TICK PARASITE

Hunterellus hookeri Howard [1]

By H. P. Wood, *Bureau of Entomology*

Introduction

Only two hymenopterous parasites of the Ixodoidea or ticks have ever been discovered. About one of these (*Ixodiphagus texanus* How.) almost nothing is known. The other, belonging to the same tribe of encyrtine chalcidids, *Hunterellus hookeri* Howard, is of peculiar

[1] Published by permission of the Chief of the Bureau of Entomology.

interest. Though there are as yet some details lacking to a complete knowledge of the life history of this insect, we know its history in general. We submit this knowledge in the hope that we may soon be able to supply the remainder.

Hunterellus hookeri was first collected by the writer in the nymphs of *Rhipicephalus sanguineus* Latreille (=*texanus* Banks) on April 20, 1908 at Corpus Christi, Texas. Doctor L. O. Howard described the species in the *Canadian Entomologist* for July 1908 p. 239–241. Search made in 1909 by C. W. Howard in Portuguese East Africa resulted in his finding this same species attacking *Rhipicephalus sanguineus* nymphs at Lourenco Marques. On June 18, 1910, two nymphs of *Dermacentor parumapertus marginatus* were received at the Dallas laboratory which were taken on a jackrabbit (or a dog?) by Mr. McLure Lewis, a correspondent at Green Valley, California. When the nymphs were received at Dallas, one of them was found to be parasitized. The nymphs were placed on sand and on July 1st, thirteen parasites emerged from one of them. The other nymph molted to a male *Dermacentor parumapertus marginatus*. The nymph from which the parasites emerged was determined by Mr. N. Banks as the same species. The parasites were determined by Doctor Howard as *Hunterellus hookeri*.

Two hosts are known, *Rhipicephalus sanguineus* and *Dermacentor parumapertus marginatus*. A brief outline of the life history of these ticks is essential to an understanding of the life history of the parasite.

The two species may be grouped together for the purpose, as their life histories are nearly the same. The eggs, which are deposited on the ground, hatch and the larvæ come forth ready for a host. Upon finding a host the young ticks feed until replete with blood. They then drop to the ground, seek a crack or crevice for protection and there undergo the transformation to the nymphal stage. The nymph engorges to repletion, after which it drops to the ground to molt. While the nymph is engorging or after it has become engorged, parasitism takes place. Both male and female adults, like the other two stages, wait on grass for the appearance of a host. A host found, the adult ticks feed and mate.

It was first supposed that the insect was confined to a limited territory, but late collections indicate a wide range. To date, the species has been taken at Corpus Christi and Brownsville, Texas, also Green Valley, California in the United States, and from Monterey, Mexico[2] and from Lourenco Marques, Portuguese East Africa.

[2] November 25, 1909, Mr. F. C. Bishopp and Mr. E. A. Schwarz collected nymphs of *R. sanguineus* from dogs. Some of these were parasitized, but the parasites never matured and the determination is based on immature specimens.

Life History and Habits

In describing the life history of the parasite, we shall start with adults emerging from a small round opening at the posterior end of the nymph. (See Pl. 17, Fig. 5). The insects often encounter considerable difficulty in getting out through the small passage way. Should the nymph become somewhat dry, it occasionally happens that the parasites are unable to emerge. As soon as the male has extricated itself, it immediately seeks a female. Once free, the female awaits the male, meanwhile preening her antennae and wings with her forelegs. The male rapidly fertilizes the females, the sexual act requiring but a few seconds. As soon as she is fertilized the female starts off hastily in search of her victim. To the tick larva the parasite pays no attention, but attempted oviposition has been observed in both a male and unengorged female of *R. sanguineus*. All that the parasite requires is a nymph at least partially engorged. In nature both nymphs on the ground or on the host seem to be attacked. On the host animal the tick parasite is perfectly at home crawling through the hair as naturally as a flea. A nymph which has become quiescent before molting seems to be in no danger from the parasite. It appears to delight in motion on the part of its victim. When crawling about on the tick host, the parasite makes little use of its wings, but when free the insect moves about in short flights. Often the parasite will insert its ovipositor immediately after reaching the nymph, but sometimes it takes a few seconds of examination and at other times longer. After inserting its ovipositor, which remains inserted from about two to twenty seconds, the parasite usually leaves its host and seeks another victim. It may, however, wait and insert its ovipositor again, but never has been observed to oviposit more than twice in the same tick. Although feeding is not necessary before oviposition, this parasite has been seen to imbibe sweetened water when offered the chance.

In from eight to fifteen days in October the characteristic striped appearance (See Pl. 17, Fig. 12) of the parasitized nymph becomes evident. In about forty-four days during October and November, the parasites emerged as adults. The parasitic period within the nymphs is very nearly the same as the molting period of the nymphs.

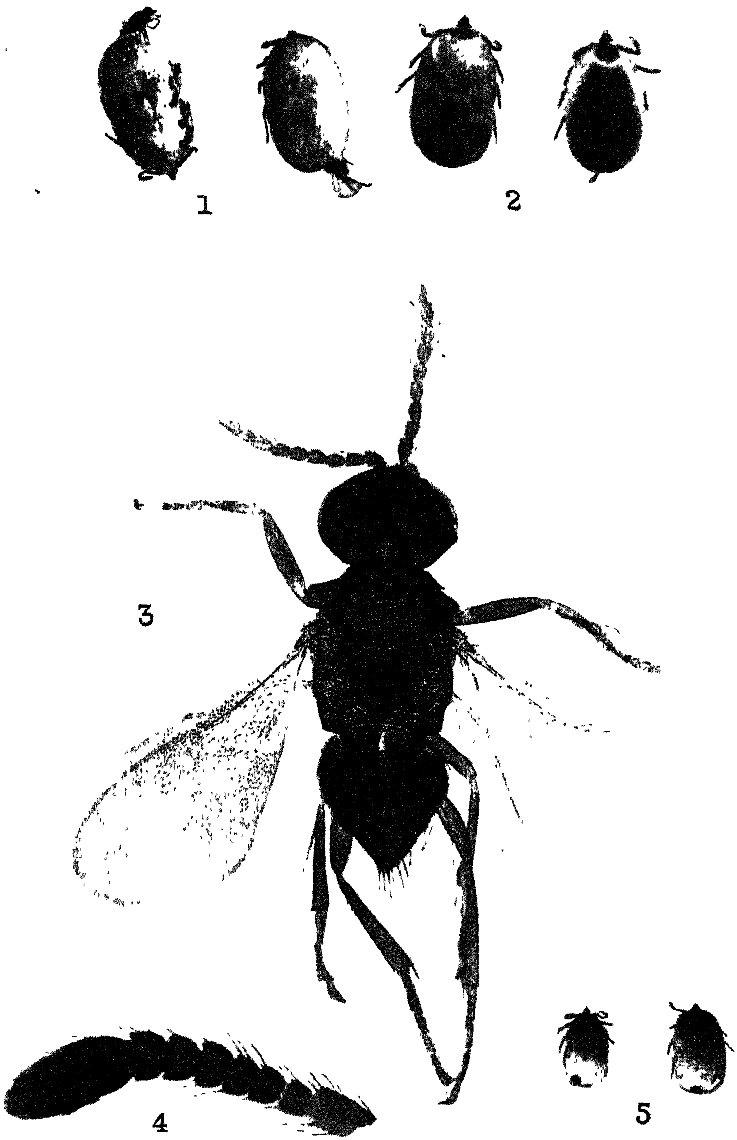
A study of the accompanying table (No. 1) will give some idea as to the number of parasites per tick, the proportion of sexes[3] and the time spent by the parasite within the nymph.

[3] The sexes are easily distinguished by the difference in the antennae. The segments of the antennae of the female are broader than long with the end segment club shape, while in the male the segments are longer than broad, the end segment being the same width as the others. Compare Pl. 17, Figs. 3 and 4.

RECORD OF PARASITES (*HUNTERELLUS HOOKERI*) REARED FROM *RHIPICEPHALUS SANGUINEUS*

Host collected	No. Nymphs	Days to emerge	Parasites emerged ♂	♀	?	Total	Host collected	No. Nymphs	Days to emerge	Parasites emerged ♂	♀	?	Total
1908 Apr. 20	1	32				10	1908 May 28–29	1	24 or 25	2	4		6
" "	1	32				17	" "	1	24 or 25	2	8	2	12
" "	1	33				6	" "	1	24 or 25	1	7	2	10
" "	1	33	5	6		11	" "	1	24 or 25			4	4
" "	1	33				6	" "	1	24 or 25			5	5
May 28–29	1	22 or 23	1	5		6	" "	2	24 or 25	2	2	1	5
" "	1	22 or 23	1	4		5	" "	1	25 or 26	0	3		3
" "	1		1	3		4	" "	1	25 or 26	3	3	2	8
" "	1	22 or 23	1	8		9	" "	1	25 or 26	1	6		7
" "	1	23 or 24	1	4		5	" "	1	25 or 26	1	6		7
" "	1	23 or 24	0	6		6	" "	1	25 or 26	2	6		8
" "	1	23 or 24	1	4		5	" "	1	25 or 26	4	6	1	11
" "	3 (a)	20 or 24	3	10		13	" "	2	25 or 26	0	5		5
" "	3 (b)	21 or 24	2	8		10	" "	1	25 or 26	1	3		4
" "	3 (c)	22 or 23	3	10		13	Oct. 16, 1908	1	30				6
" "	1	24 or 25	1	5		6	" "	1	31				8
" "	1	24 or 25	0	3	1	4	" "	1	51				8
" "	1	24 or 25	2	4		6	Nov. 6, 1908		66				3
" "	1	24 or 25	2	2		4	" "		67				8
" "	1	24 or 25	0	4		4	Sept. 9–10, 1909	1	29 or 30				5
" "	1	24 or 25	2	6		8	" "	1	32 or 33				6
" "	1	24 or 25	3	6		9	" "	1	32 or 33				4
" "	1	24 or 25	4	6		10	" "	1	32 or 33				3
" "	1	24 or 25	2	3	1	6	" "	1	32 or 33				4
" "	1	24 or 25	2	11		13	" "	1	32 or 33				3
" "	1	24 or 25	2	11		13	" "	1	32 or 33				3
" "	1	24 or 25	1	5	1	7	" "	1	33 or 34				4
" "	1	24 or 25	3	3		6	Nov. 25, 1909	1	Removed				5
" "	1	24 or 25	1	5		6	" "	1	"				3
							June 11, 1910	1	20				13

(a) = 6 from one nymph.
(b) = 7 from one nymph.
(c) = 5 from one nymph.



Hunterellus hookeri Howard:—Fig. 1, Parasites emerging from nymphs of *Rhipicephalus sanguineus* Latr. x 6.3; Fig. 2, Nymphs of *R. sanguineus* showing characteristic appearance following parasitism, x 6.3; Fig. 3, *Hunterellus hookeri*, male, x 54; Fig. 4, antennæ of female of same, x 1450; Fig. 5, emergence orifices in nymphal ticks, x 3.6.

The percentage of parasitism varies considerably in the same locality. We have been able to secure at times an abundance of parasitized ticks at Corpus Christi, Texas, while at others, though it may have been very near the same season of the year, either no nymphs were found or the nymphs found were not parasitized.

The records in the table show the production of about one male to three females. As may be seen the proportion of males to females in a single nymph varies considerably, although it usually happens that there is an excess of females and in no case has the proportion of males exceeded that of females. The maximum number of parasites per tick was seventeen, the minimum three and the average eight. It took from twenty to sixty-seven, with an average of thirty-two days from the date of collection for the adults to emerge.

Description of Parasitized Nymph

For several days after being parasitized the nymph appears normal. The first indication of parasitism is swelling, soon followed by an irregular striped appearance (See Pl. 17, Fig. 2) caused by the larvæ of the parasite as seen through the nymphs' skin. This appearance gradually passes away as the body fluids are taken up by the parasite. Just before emergence, the front end of the body is black and the posterior part yellowish translucent. This is more pronounced in some cases than in others.

Artificial Parasitism

Early attempts to breed the parasites proved failures. Mr. W. A. Hooker's trials gave negative results, as did also the author's early tests. This was probably due to the extreme heat when the attempts were made. Our efforts finally proved successful and it was found very easy to breed the parasite, using *Rhipicephalus sanguineus* as a host. It si quite likely another generation might have been bred but for cold setting in.

Considerable difficulty was anticipated in breeding the parasite owing to its minuteness. The head and body length measures only about one millimeter. A large box was prepared in which the breeding was to be done. In actual practice, however, this box was found to be of no value. When the tick was attached to its host, it was necessary simply to allow a female parasite its freedom on the host. It would search out the nymphs. When the nymph was free, it was only necessary to put a glass over the parasite and nymph to prevent their escape.

The table below shows the results obtained in the breeding experiments:

TABLE II. RECORD OF RESULTS OF BREEDING OF *H. HOOKERI*

Parasitized	No. Nymphs	Date Emerged	Parasites emerged				Days to Emerge	Temperature (F.)		
			♂	♀	?	Total		Max.	Min.	Mean.
Oct. 12, 1909	1	Nov. 26	1		8	9	43	94	41	72 05
Oct. 13, 1909	1	Nov. 26	1		9	10	44	94	41	69 03
Oct 14, 1909.	1	Nov. 27				8	44	94	41	*

Besides those that emerged successfully there were five other nymphs that were parasitized at the same time, but which failed to produce adult parasites. When the nymphs were opened, one produced ten; one, thirteen; one, eight; and one, eleven adults; and the fifth nymph was found to contain four immature stages. An attempt was made to carry these parasites another generation, but without results, the failure due possibly to the lateness of the season. One tick which produced thirteen parasites appeared to be parasitized only about three times; in no case as many as thirteen times. This might suggest that the parasite deposited several eggs each time she inserted her ovipositor, or possibly some form of polyembryony.

Economic Importance

Several attempts have been made to cause the parasite to develop on hosts other than those on which it was collected, but thus far without positive results. It seems, however, since the parasite naturally breeds on at least two widely separated genera that further experiments should prove successful. It is true that the abundance of *Rhipicephalus sanguineus* varies greatly where the parasite is found but how much of this variation is due to the parasite cannot be determined without further study. In any case, *R. sanguineus* has always been found in sufficient numbers in south Texas to prove that the tick is able to thrive in spite of the parasite. The effect can be one of only partial control.

On November 14, 1908 a shipment of 200 nymphs, divided into two lots, one in a wooden box containing tissue paper, the other in a mailing tube containing green sawdust, were sent to Prof. C. P. Lounsbury at Cape Town, South Africa. Parasites emerged from each lot, but attempts to cause attack of the South African ticks were failures. Other lots of nymphs were collected in south Texas and shipped to Mr. C. W. Howard at Lourenco Marques, Portuguese East Africa and to Prof. P. Silvestri, Portici, Italy. In neither case were the parasites successfully reared.

* In refrigerator one day before emergence.

I wish to acknowledge the assistance in the work upon which this paper is based of Dr. L. O. Howard and Messrs. F. C. Bishopp and W. A. Hooker.

A NOTE ON XYLOCRABRO STIRPICOLA PACK

By A. B. Gahan

While records of the nesting habits of Crabronidæ are not wanting in entomological literature, the following observations are believed to be of sufficient interest for publication.

Early in March of the present year (1911) the Entomological Department of the Maryland Experiment Station received from a correspondent in Hagerstown a lot of twigs of *Catalpa bungei*, accompanied by a letter stating that a young tree was being badly injured by some insect boring in the twigs. Examination of the twigs revealed the fact that they were being utilized by some species of Crabronid as a nesting place. In some cases the stems had been hollowed out to a depth of twelve to fifteen inches, and had, of course, been killed for that distance. Some twigs contained as many as twenty-five or thirty of the larvae, each in its separate cell.

The larvæ at time of receipt were plump, pure white grubs with the abdominal spiracles quite prominent. Each was enveloped in a thin, pale, brownish cocoon. They were evidently just beginning to pupate, as the constriction between the abdomen and thorax was already appearing.

The cells containing the larvæ were separated by chewed up bits of the pith, and in the end of each cell was a mass of fragmentary remains of the insects which had served as the larval food. Examination of these fragments indicated that the principal part of the food had consisted of a small metallic blue-green Dipteron of the family Stratiomyidae. In some instances the remains of a grayish species, apparently of the same family, were found.

Adults were obtained from the twigs on May 8, 1911, and proved to be *Xylocrabro stirpicola* Packard. Professor Riley has recorded the finding of nests of this species in Osage Orange, and there are other records of its having been found in raspberry. The probable explanation for its choice of this catalpa as a nesting place and the accompanying injury, is to be found in the fact that the tree had evidently been pruned, leaving the soft pith exposed and furnishing an ideal and inviting place for the wasp to nest.

STUDIES IN THE BIOLOGY OF THE BOLL WEEVIL IN THE MISSISSIPPI DELTA REGION OF LOUISIANA[1]

By R. A. CUSHMAN, *Bureau of Entomology, U. S. Department of Agriculture*

The information contained in the following pages was obtained in a series of studies in the life history and biology of the boll weevil, carried on by the writer at the Delta Boll Weevil Laboratory at Tallulah, La. Owing to the fact that what work was accomplished along these lines was done in what time could be spared from other investigations, the methods employed were more or less crude and the results obtained somewhat meager. However, the data obtained are of considerable interest and very suggestive of opportunities for future investigation along similar lines.

The experiments were started with the idea of determining the maximum and minimum number of generations during a season, but as the work progressed new lines of investigation presented themselves, and several of these were studied to some extent.

As no provision had been made to have cotton in the proper stage at an early date and since the season was very backward, the beginning of the work was unavoidably delayed until June 21, when squares began to appear in the field. On account of the lack of time necessary for carrying on the work in plant cages, it was necessary to utilize picked squares and cages of various sorts. This introduced the first unnatural condition. In nature, an infested square stays on the plant six or seven days after being punctured, during which time it grows and retains its moisture to a large extent. Under the conditions as imposed in the experiments the squares began drying before being infested. This had the effect of limiting the food supply of the developing larvæ, and caused a large percentage of the weevils reared to be small, poorly developed individuals. This was not particularly noticeable during the hotter weather, when the developmental period was of short duration; but late in the season, when the developmental period was some days longer, it became such a serious matter that very few weevils were reared, and the work had to be concluded before breeding in the field had ceased. This difficulty was increased by the necessity of importing squares from Texas during September and October, owing to the practically total infestation at Tallulah. The failure to determine the point originally intended was due to this factor.

Throughout the work the squares either dried or rotted badly, according as they were placed after infestation in well ventilated or

[1] Published by permission of the Chief of the Bureau of Entomology.

close breeding cages. Nevertheless, eight hundred and sixty-eight weevils, having developmental periods ranging from eleven to nineteen days in duration were reared, and on these the data and conclusions in the following pages are based.

Methods

In starting the work eleven hibernated female weevils and as many males taken in the field were used. The females were captured as follows: five on June 21, two on June 22, and four on June 23. These were paired and each pair placed in a tumbler, closed by a square of cheese cloth, with cotton squares from which the involucres had been stripped. The squares were renewed daily and examined for egg punctures, the infested ones being placed in breeding jars, each jar containing the squares infested by all the weevils during one day. Throughout the oviposition period careful daily record was kept of the number of eggs deposited and the number of squares infested by each weevil. The female weevils were numbered H. 1 to H. 11 (meaning hibernated weevil No. 1, etc.). The males were removed as soon as oviposition was well under way. H. 1 was discarded from the series on June 27, as it had, up to that time, not oviposited, and H. 4 was thrown out on June 30, having deposited only two eggs. No weevils were reared from the eggs of this individual.

It was originally planned to use the earliest ten female weevils and the latest ten of each generation throughout the season. The number of generations reared from the earliest females would be the maximum and the number reared from the latest females the minimum number of generations possible during the season. This was carried out to the fourth generation with the earliest females, but of the latest females only those of the first generation were reared. At the time when the last eggs of the latest first generation weevils were being deposited, about the middle of September, the squares from Texas were being used, and very few adults were reared. Moreover, no squares except those from Texas were obtainable, and no attempt was made to carry the work beyond the first week of October.

Each of the female weevils which were kept for breeding the next generation was labeled with the number of the generation to which it belonged together with a letter, indicating whether it was one of the earliest or one of the latest of its generation. Thus weevil No. 4.c was the third earliest female weevil of the fourth generation and No. 1.y was the next to the last of the first generation. Each female was placed with a male in a tumbler, given fresh squares daily, and otherwise treated exactly as were the hibernated weevils.

The male weevils used were obtained sometimes from the field and sometimes from the breeding cages.

The squares infested by each series of weevils were kept in separate lots, but all those infested by the weevils of a given series during one day were placed in a common breeding cage. Thus each lot of infested squares represented one day's work of all the weevils of one series.

In order to equalize as far as possible the humidity surrounding the various lots of squares, small lots were placed in tumblers or even in large tubes with cheese cloth covers, while larger lots were placed in lantern chimneys with a square of cheese cloth over each end. The last were placed on their sides to admit of a free circulation of air about the squares. In spite of these precautions many of the squares dried too rapidly, while others became sodden and decayed badly. The greatest difficulty was experienced with the earliest infested squares of each generation, always small in number, which dried so rapidly that few of them produced adult weevils.

The methods employed in the more minute studies of the various stages and in obtaining data on other points will be described under the several topics.

Oviposition

In depositing an egg within a square, the female weevil first tests the square minutely, running over it excitedly and feeling it with the antennæ. Finally selecting a suitable place, usually on the surface of the calyx toward the base of the square, she begins drilling a hole by pulling off a little flake of the outer epidermis. Then, with her feet strongly braced and by gnawing and pushing with an augur-like motion, she thrusts her beak into the tender portion of the square. At the bottom of the puncture she makes a small cavity by gnawing, at the same time moving about the hole with the beak as a pivot. Withdrawing her beak she turns about with the center of her body as a pivot. This places the tip of her abdomen directly over the puncture, into which she thrusts her ovipositor, depositing a single egg in the chamber at the extreme end of the puncture. As she withdraws her ovipositor she plugs the puncture with a particle of excrement, pressing it down with the tip of her abdomen.[1]

Sometimes the weevil fails to locate the puncture immediately with her ovipositor. In this event she searches excitedly, moving the tip of the abdomen about, feeling carefully over the surface of the square. In this search, however, she never moves her front feet, evidently

[1] In the progress of the work many egg punctures were observed which were not plugged with excrement. These could, with a lens, be distinguished from the feeding punctures by a thin film of moisture closing the puncture just below the surface of the square, and due to the moisture from the ovipositor.

using the position of these as a guide to the distance through which she should search. Failing to locate the puncture in this way, she again turns around and searches for it with her beak and antennæ. If still unsuccessful she abandons the search and makes a new puncture.

Several weevils were watched during the act of oviposition and the various portions of the process carefully timed. The time required for making the puncture varied from 1 min. 20 secs. to 8 mins. 27 secs., with an average of 3 mins. 36 secs. In but two cases did the weevil fail to locate the puncture with the ovipositor immediately. In one case the weevil found it after 1 min. 15 secs., and in the other after several minutes search the weevil abandoned it and started a new puncture. For the deposition of the egg and the sealing of the puncture the time required varied from 35 secs. to 1 min. 40 secs., with an average of 59 secs. The total time for the whole process varied from 2 min. 45 secs. to 9 mins. 30 secs., with an average of 4 mins. 41 secs. Exclusive of the time lost in hunting for the puncture, one of the weevils accomplished the act in 1 min. 55 secs.

Periodic Division of Daily Oviposition

For observations on this point the day was divided into five periods as follows: early morning, from daylight to 9.00 a. m.; late morning, 9.00 a. m. to 1.00 p. m.; early afternoon, 1.00 p. m. to 5.00 p. m.; late afternoon, 5.00 p. m. to dark; and night, dark to daylight. At the time the observations were made, from 5.00 p. m. July 20 to 5.00 p. m. July 22, daylight occurred at about 4.00 a. m. and dark at about 7.30 p. m. The two days were partly cloudy but bright and the two nights clear and moonlight. During the entire time the weevils were kept in large tubes on covered porches, during the day at the laboratory and during the night at the observer's home. At the end of each period all of the squares were removed and fresh ones supplied. All infested squares were opened to verify the fact of oviposition. The first generation weevils, 1. a–k (exclusive of 1. h), ten in number, were used. Weevil 1. b was eliminated from the results, as it deposited only one egg during the two days.

The figures obtained show that of the nine weevils six deposited eggs during the night period. On the first day the four daylight periods ranked in hourly oviposition as follows: late afternoon, early afternoon, early morning, and late morning, the weevils being much more active in the latter half of the day. On the second day the preference for the afternoon is again shown, but these two periods are reversed in order, as are also the two morning periods. The total results, obtained by adding the two days oviposition, are given in Table I. This table shows that, although there was a decidedly

larger percentage of eggs deposited in the early afternoon, the rate of oviposition is faster in the later period. There is apparently little preference on the part of the weevils between the two morning periods. The record of weevil 1. c is omitted from this table, as it died during the second day, and its record is therefore incomplete.

TABLE I

SUMMARY OF PERIODIC DIVISION OF OVIPOSITION

Period	Total eggs laid	Time in two days	Average No. eggs per hour	Per cent total oviposition in each period	Average eggs per weevil per hour.
5 p. m.–7.30 p. m...	25	5 hours	5 00	23.15	0.63
7.30 p. m.–4 a. m	10	17 "	.59	9.26	0.07
4 a. m.–9 a. m.....	21	10 "	2 10	19 44	0.26
9 a. m.–1 p. m.	17	8 "	2 13	15.74	0.27
1 p. m.–5 p. m............. ...	35	8 "	4 38	32.41	0 55

Total, Daily, and Maximum Oviposition and Oviposition Period

Since only enough eggs from the first weevils of each generation were needed to insure a supply of female weevils for the subsequent generations, these weevils were not fed beyond a few days. No data were therefore obtained on their total oviposition. Data of this sort were obtained only for the hibernated weevils and the latest weevils of the first generation.

Oviposition of hibernated weevils.—After the discarding of weevils H. 1 and H. 4 nine hibernated weevils were left for carrying on the observations. These began ovipositing within from one to six days after being placed in the cages. The oviposition period lasted from fourteen to fifty-three days, during which time the weevils deposited from 51 to 304 eggs. The average oviposition was 203.33 eggs and the average period 34.44 days. The average daily individual oviposition varied from 3.4 to 7.66 eggs, with a total average of 5.9 eggs per day. The maximum number of eggs deposited by any weevil during one day was twenty. In all probability, had these weevils been at large, the oviposition period would have been longer and the average daily and maximum oviposition smaller, as the great abundance of squares and the elimination of the search for them undoubtedly conduced to rapid oviposition. Probably also the inability of the confined weevils to remate had some effect on the oviposition. The life of the weevils after the completion of oviposition varied from death on the last day of oviposition to ten days after the last egg, although only two of the nine lived more than three days.

The results of these observations are summarized in Table II.

TABLE II

SUMMARY OF OVIPOSITION OF HIBERNATED WEEVILS

Weevil No.	Date placed in cage	Date first egg	Date last egg	Date of death	Oviposition period. Days	Total number eggs	Average daily oviposition	Maximum No. of eggs one day
H. 2..	June 21	June 23	July 29	July 30	37	248	6.70	16
H. 3..	" 21	" 27	" 10	" 16	14	66	4.71	8
H. 5	" 21	" 22	" 13	" 14	22	115	5 23	14
H. 6..	" 22	" 25	" 9	" 10	15	51	3.40	9
H. 7....	" 22	" 24	Aug. 15	Aug. 25	53	229	4.32	16
H. 8..	" 23	" 24	" 11	" 14	49	282	5.75	16
H. 9..	" 23	" 24	" 3	" 6	41	242	5.90	17
H. 10.. ...	" 23	" 24	July 31	" 2	38	291	7.66	18
H. 11.....	" 23	" 24	Aug. 3	" 3	41	304	7.41	20
Totals						1,830		
Averages					34.44	203.33	5.90	14 9

Oviposition of latest first generation weevils.—The work was concluded while the latest of the first generation weevils were still ovipositing, but somewhat desultorily. The work with these weevils was, however, carried on over a period of 49 days and some data of interest were obtained. Of the nine weevils, of which the lot originally consisted, four died without producing any eggs and one was lost after five days of ovipositing. Of the four remaining, one was ovipositing throughout the 49 days, one for 44 days, and one for 43 days, while the fourth had apparently ceased ovipositing after 47 days. During the above periods the weevils deposited the following numbers of eggs: 295, 211, 183 and 198. The average total oviposition for the four weevils was 221.75 eggs. The average daily oviposition was 4.78 eggs, and the maximum number of eggs deposited by any one weevil during one day was twelve. These results are summarized in Table III.

TABLE III

SUMMARY OF OVIPOSITION OF LAST WEEVILS OF FIRST GENERATION

Weevil No.	Date first egg	Date last egg	Oviposition period, Days	Total number eggs	Average daily oviposition	Maximum number of eggs one day
1. r	Aug. 21	Oct. 6	47	198	4.04	9
1. s	" 21	" 8	49	295	6.02	11
1. x	" 26	" 8	44	211	4.79	12
1. z	" 27	" 8	43	183	4.26	9
Totals				887		
Averages			45.75	221.75	4.78	10.25

The Life Cycle

The life cycle of the weevil may properly be divided into three periods: the developmental, preoviposition (the time between emergence and the beginning of oviposition), and oviposition periods. The last has already been discussed. The developmental period may be divided into the egg or incubation, larval, pupal and postpupal or teneral adult periods. The last is the time after the casting of the pupal skin, during which the weevil remains in the pupal cell.

Preoviposition Period

Data on this period in the life of the weevil was obtained from 43 weevils, representing the earliest individuals of generations one to four and the latest of generation one. As far as possible the date of copulation was obtained. This date is, however, very liable to error, since this act may be repeated between the same two weevils a number of times and even after oviposition has commenced. The time observed to have elapsed between emergence of the female and copulation varied in thirteen cases from two to seven days. In one of the two cases, in which seven days had elapsed, the original male weevil died on the sixth day and a new one was substituted. On the seventh day the pair were in copula and two eggs had been deposited. In the other seven day case copulation was also observed on the date of first oviposition. Copulation must, therefore, have taken place sometime before observed, in all probability by the third day. These observations, therefore, mean little except as they show the minimum time required for the proper maturing of the sexes for copulation.

As mentioned above, the minimum time from emergence of the females to copulation was two days. The male in this pair was, however, one day older than the female, and copulation in this case may have been due entirely to the extreme amour of the male, and does not necessarily mean that the ovaries of the female were ripe for fertilization. In two cases the time elapsed between emergence and copulation was three days. In one of these pairs the male was four days old at the time of copulation, and in the other both sexes were of the same age. These three cases would seem to indicate that the normal time necessary for the ripening of the sexual organs in both sexes is about three days.

The total period from emergence to oviposition varied from five to twenty-three days. The seven longest periods occurred in the weevils taken as the earliest of the fourth generation. Three of these were reared from squares infested by the latest weevils of the first generation and the rest, from those infested by the early third generation weevils. The long time required by these weevils is probably partly due

TABLE IV

SUMMARY OF PERIOD FROM EMERGENCE TO OVIPOSITION

Weevil groups	Date of emergence	Date of copulation	Number of individuals	Days emergence to copulation			Date of first egg	Number of individuals	Days emergence to oviposition		
				Min.	Max.	Mean			Min.	Max.	Mean.
Earliest weevils of first generation	July 8–11	July 13–15	9	2.00	7.00	4.33	July 14–19	11	5 00	8.00	6.00
Earliest weevils of second generation	July 29–31	.....	.....	.....	.....	.....	Aug. 5–7	7	5 00	8.00	6.29
Latest weevils of first generation	Aug. 14–22	Aug. 19	1	5 00	5.00	5.00	Aug. 21–27	7	5.00	7.00	6.29
Earliest weevils of third generation	Aug. 19–21	Aug. 22–26	3	3.00	7.00	5 33	Aug. 26–28	9	6.00	9.00	6.89
Earliest weevils of fourth generation	Sept. 10–20	.....	.....	.....	.....	.....	Sept. 18–Oct. 8	9	8.00	23.00	12.89
Totals and averages	.....	.....	13	2.00	7.00	4.46	.....	.....	5.00	23.00	7.72

to the fact that they were reared at the time when the larval food was insufficient, on account of the long period required for development and the poor condition of the squares supplied. They do not, therefore, probably represent the normal time required by weevils at that season, but exceed this time by several days. The average time of 7.72 days is also probably somewhat in excess of the normal average.

The number of eggs produced on the first day of oviposition shows remarkable variation, from one to seven. Of the forty-three weevils, sixteen produced one egg and thirteen two eggs; in other words more than 67 per cent of the weevils deposited, on the first day of oviposition, less than three eggs. Some of the others responded more readily to the incentive furnished by the abundance of squares and probably exceeded their normal habit.

A summary, by groups, of the results of these observations are shown in Table IV.

Developmental Period

Incubation period.—Data on the incubation period were obtained from six lots of eggs. Of these, four lots, deposited June 27 to July 4, showed a period of about three days, and two lots, deposited July 8–10, gave a period of about two and a half days. A study of the average temperatures during the incubation periods of these six lots of eggs shows that the average maximums for the eggs having the shortest incubation periods were much higher than for those requiring the longer period, the means slightly higher, and the minimum slightly lower. This indicates that the maximum temperature is the determining factor in the duration of the incubation period. This is shown very clearly in Table V.

TABLE V

TABLE SHOWING RELATION BETWEEN INCUBATION PERIOD OF BOLL WEEVIL AND TEMPERATURE

Date of oviposition	Date of examination	Days elapsed oviposition to examination	Number of individuals	Number unhatched	Number hatched	Estimated duration incubation period	Average temperature during incubation period		
							Max.	Min.	Mean
June 27–28	July 1	3 5	6	1	5	3.0	86.4	69.7	78.1
" 28	" 1	3.0	4	3	1	3.0	86.3	69.2	77.8
" 29	" 2	3.0	10	4	6	3.0	86.8	69.2	77.8
July 3–4	" 7	3 5	several	0	all	3.0	86.6	71.8	79.3
" 8–9	" 11	2 5	12	1	11	2.5	91.0	68.8	79.9
" 9–10	" 12	2.5	10	2	8	2.5	91.7	69.3	80.5

For determining the duration of the several stages of the developmental period beyond the egg, a start was made with 107 eggs of known date. The date of hatching was estimated on the basis of the incubation period as previously determined. Of the eggs used nine were deposited June 27–28, five June 29–30, thirteen June 30–July 1, forty July 1–2, twelve July 3–4, and twenty-eight July 6–7. The incubation period for the last of these lots was placed at two and one half days and for the others at three days. The squares containing these eggs were opened a short time before pupation was expected to take place. Thereafter they were examined daily and the dates of pupation, formation of the teneral adult, and emergence recorded. By these means the actual progress of the weevils from the egg to emergence was ascertained with considerable accuracy. Of the original 107 individuals, the larval period of 98, the pupal period of 50, and the postpupal or teneral adult and total periods of 58 were determined.

The results obtained indicate that the larval period occupies slightly less than one half of the total developmental period, and approximately equals the incubation and pupal periods combined. The larval period showed somewhat greater variation than the inactive periods, the excess being probably due to the drying of the opened squares, while the egg and pupal periods were influenced largely by the temperature. The variation of one to three days in the postpupal period can be explained only by the peculiarities of the individual weevils.

The average mean total developmental period of the weevils under observation was somewhat higher than of weevils from undisturbed squares infested during the same period, due to the more rapid drying of the opened squares. The average developmental period of the 92 weevils bred from unopened squares was 13.4 days, 0.4 of a day less than for those in the opened squares. The average mean developmental period as determined above taken together with the average preoviposition period, shown in Table IV, gives an average total life cycle, exclusive of the oviposition period of about twenty days. The minimum, however, as shown by the figures of these two sets of observations, may be as low as sixteen days.

The data on the total developmental period and its several divisions are shown in Table VI.

The developmental period for individual weevils throughout the season was taken as the time between the average date of oviposition and the average date of emergence. Since examinations were made only once in twenty-four hours, this gives a possible variation of two days, and, when one observation was omitted, of three days. Obtained

TABLE VI

SUMMARY OF TOTAL DEVELOPMENTAL PERIOD

Date of deposition of eggs	Number of individuals.	Incubation period. Days	Date of hatching	Date of pupation	Number of individuals	Larval period. Days			Date of teneral adult	Number of individuals	Pupal period. Days			Date of emergence	Number of individuals	Teneral adult period. Days	Total period oviposition to emergence. Days		
						Max.	Min.	Mean			Max.	Min.	Mean				Max.	Min.	Mean
6.27–28	9	3	6.30–7.1	7.7–8	9	8	6	7											
6.29–30	5	3	7.2–3	7.8–9	5	7	5	6											
6.30–7.1	13	3	7.3–4	7 8–9	1	6	4	5	7.12	1	4	3	3.5	7.14	1	2	14	13	13.5
				7.9–11	9	8	5	6.5	7.13	5	4	2	3	7.14	4	1	14	13	13.5
														7.15	1	2	15	14	14.5
									7.14	2	5	3	4	7.15	1	1	15	14	14.5
														7.16	1	2	16	15	15 5
									7.15	1	6	4	5	7.16	1	1	16	15	15.5
7.1–2	40	3	7.4–5	7.10–11	18	7	5	6	7.14	4	4	3	3.5	7.15	3	1	14	13	13.5
														7.16	1	2	15	14	14.5
														7.16	5		15	14	14.5
				7.11–12	20	8	6	7	7.14	4	3	2	2.5	7.16	4	2	15	14	14 5
									7.15	2	4	3	3.5	7.16	2	1	15	14	14.5
														7.16	4		15	14	14 5
				7.12–13	2	9	7	8											
7.3–4	12	3	7 6–7	7.12–13	11	7	5	6	7.15	3	3	2	2.5	7.17	3	2	14	13	13.5
									7.16	6	4	3	3.5	7.17	2	1	14	13	13.5
														7.18	4	2	15	14	14.5
				7.13–14	1	8	6	7											
7.6–7	28	2.5	7.9–10	7 13–14	2	5 5	3.5	4.5	7.17	2	4	3	3.5	7.19	2	2	13	12	12 5
				7.14–15	15	6.5	4.5	5.5	7.18	15	4	3	3.5	7.19	5	1	13	12	12.5
														7.20	10	2	14	13	13.5
				7.15–16	4	7.5	5.5	6.5	7.18	1	3	2	2.5	7.21	1	3	15	14	14.5
									7.19	3	4	3	3.5	7.20	1	1	14	13	13.5
														7.21	2	2	15	14	14.5
				7.16–17	1	8.5	6.5	7.5	7.22	1	6	5	5.5						
Totals and averages	107	2.8			98	7.3	5.2	6.3		50	3.9	2.8	3.3		58	1.6	14.3	13.3	13.8

in this manner, the total period varied from eleven to nineteen days. The former is probably a somewhat shorter time than actually elapsed in any case, but the error was counterbalanced by the later weevils in the same lot of squares. In all probability, the earliest weevils from a lot of eggs deposited within twenty-four hours came from the earliest eggs and the latest from the latest eggs, so that, other things being equal, the developmental period of all the weevils from these eggs would be equal.

One of the principal factors in causing variation in the length of the developmental period within a given lot of squares and between different lots of squares during the progress of the work was the condition of the food supply. This factor was most troublesome and most difficult of control, especially in small lots of squares and late in the season.

The following table shows the variation in the length of the developmental period and the number of weevils requiring the different periods for development:

TABLE VII

Developmental period. Days	Number of weevils
11 0	6
12 0	118
12 5	16
13.0	342
13.5	14
14.0	178
14.5	10
15.0	79
15.5	2
16.0	62
16.5	1
17.0	29
18.0	8
18 5	1
19.0	1

Another factor which largely affected the development of the weevils was the temperature. In order to indicate as nearly as possible the effect of temperature on the length of the developmental period, the weighted average daily and periodic developmental periods were calculated for all of the weevils bred. The average daily period varied in duration from twelve to nineteen days, but, as each of these extremes include data on only one weevil each, the variation is more accurately shown by the thirty-three weevils emerged on August 7, which averaged 12.45 days, and the twenty emerged September 22 which averaged 16.67 days. The average period for the 868 weevils reared was 13.68 days.

For convenience in showing the effect of the temperature on the duration of the developmental period, the dates of emergence were divided as far as possible, into groups of ten days each and the weighted average

period determined for all weevils emerging between the extreme dates. For the first period, ten days ending July 17, the average period was 14.25 days; second period, ten days ending July 27, 13.9 days; third period, ten days ending August 6, 13.54 days; fourth period, ten days ending August 16, 12.92 days; fifth period, six days ending August 22, 13.48 days; sixth period, ten days ending September 11, 14.0 days; seventh period, ten days ending September 21, 15.31 days; and eighth period, eight days ending September 29, 15.97 days.

The weighted average daily, periodic, and seasonal developmental periods are shown in Table VIII.

TABLE VIII

WEIGHTED AVERAGE DAILY, PERIODIC, AND SEASONAL DEVELOPMENTAL PERIODS

Date of emergence	Number of weevils	Average developmental period	Average for period
July 8	6	14 17	
" 9	8	14.50	
" 10	7	14.29	
" 11	11	15 14	
" 14	7	13 29	
" 15	5	13.40	
" 16	21	14.38	
" 17	7	13 86	14 25
" 18	16	12 88	
" 19	12	12 50	
" 20	17	13 18	
" 21	54	12 94	
" 22	47	12 96	
" 23	25	12.48	
" 24	25	13 16	
" 25	18	13.33	
" 26	15	13 27	
" 27	26	13.35	13.90
" 28	29	13.58	
" 29	14	14 00	
" 30	18	13.78	
" 31	29	14 69	
Aug. 1	8	13 25	
" 2	13	12.92	
" 3	23	13.17	
" 4	18	12 94	
" 5	22	13 14	
" 6	13	13 00	13 54
" 7	33	12.45	
" 8	13	13 15	
" 9	10	13.00	
" 10	11	12.82	
" 11	20	13 00	
" 12	14	13 43	

Date of emergence	Number of weevils	Average developmental period	Average for period
Aug. 13	19	13.05	
" 14	8	12 88	
" 15	6	13.17	
" 16	3	13.00	12 92
" 17	1	15.00	
" 18	3	13.00	
" 19	9	13.22	
" 20	12	13.50	
" 21	16	13.56	
" 22	5	13 60	13.48
Sept. 2	1	12.00	
" 5	2	13.50	
" 6	6	13.50	
" 7	9	13.44	
" 8	4	13.75	
" 9	5	14.80	
" 10	6	14.00	
" 11	8	13.75	14.00
" 12	7	14 14	
" 13	8	14 13	
" 14	1	14.50	
" 15	8	14.75	
" 16	2	15 75	
" 17	7	14.86	
" 18	11	15.41	
" 20	17	16.09	
" 21	10	16.40	15.31
" 22	20	16.67	
" 23	15	15.00	
" 25	12	16 08	
" 26	5	16.20	
" 27	5	15 60	
" 29	1	17.00	15.97
Oct. 4	1	19.00	
Total weevils and average for season	868	13.68	

The method of obtaining the average temperatures used to show the effect of this factor on the duration of the developmental period was as follows: all recorded maximum, minimum, and mean temperatures from the average date of oviposition to the average date of emergence

were added and the average struck. These average temperatures, together with the average developmental periods of the weevils reared during the different periods, and the number of weevils representing each period, are shown in Table IX. The relation between the temperature and the developmental period is shown in graphic form on the chart. This chart shows that the relation between the average periods and any of the temperature curves is most intimate with that of the minimum, the developmental curve going down as a rule when the minimum curve goes higher. The only exceptions to this rule are found in the first and fifth periods. These two periods were repre-

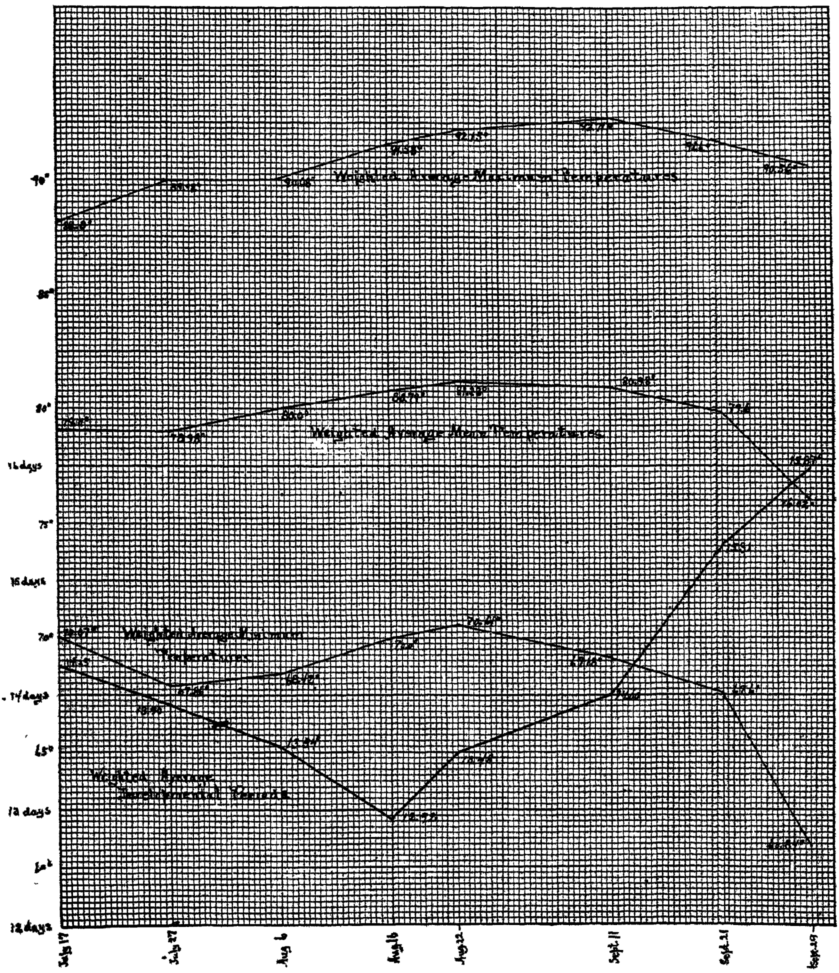


Chart showing relation between temperature and developmental period of cotton boll weevil

sented by seventy-two and forty-six weevils respectively, bred from the earliest and latest eggs of the original hibernating weevils. The lots of squares from which they were reared were small and the factor of food condition had a large effect in retarding the development. In addition, the earliest period is represented by weevils reared before the best methods of keeping infested squares were found, and these weevils were therefore further retarded by this extra deleterious effect on their supply of food. The average developmental periods in the last three periods were also considerably increased from the normal by the poor condition of the squares used late in the season. These three periods were also represented by rather small numbers of weevils. Also, the sixth period is represented only by weevils reared from the earliest eggs of two lots of weevils and hence from small lots of squares.

TABLE IX

RELATION BETWEEN LENGTH OF DEVELOPMENT AND TEMPERATURE

Number of period	Number of weevils	Average developmental period	Average date of oviposition	Average date of emergence	Average temperatures		
					Min.	Mean	Max.
1	72	14 25	June 29	July 12	70.07	79.11	88.18
2	255	13.90	July 9	July 22	67.86	78.98	89.92
3	187	13.54	" 20	Aug. 1	68.42	80.00	90.08
4	137	12 92	" 30	" 11	70.00	80.79	91.58
5	46	13 48	Aug. 6	" 19	70.61	81.23	92.15
6	41	14.00	" 24	Sept. 6	69.18	80.98	92.71
7	71	15.31	Sept. 1	" 16	67.60	79.60	91.60
8	58	15.97	" 10	" 25	60 84	76.02	90.56

Comparative Duration of Developmental Period in Males and Females

Before the work had progressed very far it was noticed that, in general, a relative majority of the earliest weevils reared from the different lots of squares were females and that the percentage of males increased as time passed. A summary of the records in this respect shows the following: of the 86 lots of squares, the females had the shortest average development in forty, the males in twenty-two, from ten lots only females were reared, from seven lots only males, and in seven cases the developmental period for both sexes was the same. The weighted average developmental period for the 475 males reared was 13.88 and for the 393 females 13.49 days, a difference of 0.39 days.

A summary of the figures based on oviposition days is given in Table X.

TABLE X

COMPARATIVE LENGTH OF DEVELOPMENTAL PERIOD OF MALE AND FEMALE BOLL WEEVILS

(In last column the signs indicate the sex showing shorter period.)

Total number of weevils	Number of males	Average period. Days	Number of females	Average period. Days	Difference
49	22	13 27	27	13.15	♀0.12
43	21	13.29	22	12 59	♀0.70
38	24	13 67	14	13 43	♀0.24
35	17	12 41	18	12.28	♀0.13
33	16	12.94	17	12 69	♀0.25
32	19	14 05	13	14 38	♂0.33
27	15	13 00	12	12.33	♀0 67
24	15	12 73	9	13 22	♂0.49
23	14	13 79	9	14.00	♂0.21
22	10	13 20	12	13 33	♂0 13
21	11	13.45	10	12 80	♀0.65
21	14	16.14	7	15 71	♀0 43
20	11	14 27	19	13 29	♀0 96
19	9	13.89	10	13.80	♀0.09
19	9	12 33	10	13.10	♂0.77
19	10	13 20	9	13.00	♀0 20
18	9	12 72	9	13.17	♂0.45
17	9	14 67	8	13 25	♀1.42
17	5	13 80	12	12.83	♀0 97
16	13	13.38	3	13 33	♀0.05
16	7	13 43	9	13 00	♀0.43
16	10	13.70	6	12 83	♀0.87
16	9	13 55	7	13.43	♀0 12
15	9	12 79	6	13.00	♂0 21
15	10	16 50	5	16.60	♂0.10
14	10	15.10	4	14 00	♀1.10
14	9	16.11	5	16 00	♀0 11
13	8	13 88	5	13 90	♂0.02
13	7	13.86	6	13 83	♀0 03
13	8	15.12	5	13.10	♀2.02
12	9	13 33	3	13.67	♂0 34
11	7	15.29	4	15.25	♀0.04
11	3	14 33	8	14 00	♀0.33
11	8	12.62	3	12 00	♀0.62
11	6	13 67	5	13.40	♀0.27
11	9	13.33	2	13.50	♂0.17
11	8	15 50	3	15 67	♂0.17
11	7	15.43	4	15.75	♂0.32
9	5	13.40	4	13.50	♂0.10
9	6	16 50	3	16 00	♀0.50
7	4	14 75	3	14.67	♀0.08
6	5	15 20	1	16.00	♂0.80
6	4	13.50	2	13.50	....
6	5	12.80	1	12 00	♀0.80
6	3	13 33	3	13.67	♂0.34
6	1	14.00	5	13.20	♀0.80
5	1	16.00	4	15.00	♀1.00
5	3	13.33	2	12.50	♀0.83
5	2	15.00	3	15 00	....
5	2	17.00	3	17.33	♂0.33
4	2	12.50	2	13 00	♂0.50
4	2	14.00	2	14.00	....
4	3	15.33	1	16.00	♂0.67
3	1	14.00	2	14.00	....
3	3	14.00	....	....	....
3	....	....	3	13 33	....
3	3	15.67	....	....	....
2	....	....	2	14.50	....
2	1	17.00	1	15.00	♀2.00
1	....	....	1	17.00	....
1	....	....	1	15.00	....
1	....	....	1	13.00	....
1	....	....	1	11.00	....
1	....	....	1	12.00	....
1	1	12.00	....	....	....
1	....	....	1	14 00	....
1	1	19.00	....	....	....
868	475	13.88	393	13.49	♀0.39

Reference to this table shows that the shorter period for females occurred in squares infested on twenty-five out of the thirty-eight days when the lots of infested squares were large and more than ten weevils were reared, and the ratio for smaller lots was only seven out of thirteen in which the females showed the shorter period. Other things being equal, the larger the lot of squares, the better the condition for food and the shorter the developmental period of the weevils reared. It was in these larger lots that the predominance of females among the earliest weevils from a given day's squares was most noticeable.

THE COCCIDÆ OF LOUISIANA[1]

Second Paper

By T. C. Barber,

Agent and Expert, Audubon Park Laboratory, U. S. Bureau of Entomology

The following list of Coccidæ is the result of a rather extended search among the flora of Audubon Park, New Orleans, La., commenced more than a year ago, to ascertain what species of scale insects were the main source of food supply for the Argentine Ant, *Iridomyrmex humilis* Mayr. A preliminary list of the "Coccidæ of Audubon Park" was published in this Journal last year (Vol. III, No. 5, p. 420–425, 1910) and included 34 species, with the host plants upon which they were collected. Since this list appeared, a considerable number of additional species have been collected, and the writer concluded to add to his own collections all species previously collected in Louisiana of which he could find reliable record, with the intention of commencing a check list of the Coccidæ of the state.

That this list is not nearly complete is proven by the number of newly-recorded species which have been added to it within the past year. Close search through our scanty available literature has resulted in finding records of 35 species previous to 1910. The present list almost doubles this number, as it includes 65 species, all but 20 of which are represented in Audubon Park. However, it is obviously more complete than the records which were available previously.

In order to insure accuracy, all determinations of material collected by the writer have been made by the Bureau of Entomology at Washington, D. C., through the courtesy of Dr. L. O. Howard. The writer herewith expresses his deep indebtedness to Messrs. J. G.

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[1]Published by permission of the Chief of the Bureau of Entomology.

Sanders and E. R. Sasscer for their unfailing kindness in determining the large amount of material submitted to them at various times.

In the case of newly-recorded species, the locality, collector's name or initials, and the host plants are given, as well as the initials of the gentleman who made the determination. For other species, the reader is referred to the brief chronological bibliography which will be found at the end of the list. A scientific name in parentheses, followed by a bibliographical number, indicates that the species was mentioned in the given article under the name given in parentheses. The general arrangement of species is on the system adopted by Mrs. Fernald in her "Catalogue of the Coccidæ of the World."

LIST OF COCCIDÆ COLLECTED IN LOUISIANA

Subfamily Conchaspinæ.

1. *Conchaspis angrœci* Ckll. (7)

Subfamily Dactylopiinæ.

2. *Asterolecanium bambusœ* Bd. Collected Audubon Park, New Orleans, and at Riverside, La., on Bamboo. T. C. B., Det. E. R. S.
3. *A. pustulans* Ckll. Collected in New Orleans by C. W. Flynn on Figs. Det. J. G. S.
4. *Lecaniodiaspis* sp. (7)
5. *Kermes galliformis* Riley. (5)
6. *K. pubescens* Bogue. (5).
7. *Pseudococcus calceolariœ* Mask. (6 & 7)
8. *P. citri* Risso. (1, 6 & 7)
9. *P.*, near *citri*. Collected on Willow at Baton Rouge, La., by G. A. Runner. Det. J. G. S. (4)
10. *P. longispinus* Targ. (*P. adonidum*, 7)
11. *P. solani* Ckll. Collected in Baton Rouge, La., by J. B. Garrett and the writer at different times. Det. J. G. S.
12. *P.* sp. (7)
13. *P.* sp. (7)

Subfamily Coccinæ.

14. *Pulvinaria acericola* W. & R. Collected Alexandria, La., by W. P. Smith. Det. J. G. S. (4)
15. *P. cupaniœ* Ckll. (7)
16. *P. vitis* Al. (7)
17. *Ceroplastes cirripediformis* Comst. (5 & 7)
18. *C. floridensis* Comst. (1 & 5.) Also collected in Audubon Park on *Robinia pseudacacia* and *Cedar deodorans*. T. C. B. Det. E. R. S.
19. *Eucalymnatus tessellatus* Ckll. (7)
20. *Coccus hesperidum* L. (*Lecanium hesperidum,* 1) (7)
21. *Neolecanium cornuparvum* Thro. (5 & 7)
22. *Touméyella turgida* Ckll. Collected Audubon Park on *Magnolia grandiflora,* T. C. B. Det. J. G. S.
23. *Eulecanium corni* Bouche. (7)
24. E. *nigrofasciatum* Perg. (5) Also collected in Audubon Park on Willow, T. C. B. Det. E. R. S.

25. *E. quercifex* Fitch. Collected in Audubon Park on Oak. T. C. B. Det. E. R. S.
26. *E.* sp. (7)
27. *Saissetia hemisphærica* Targ. (7)
28. *S. oleæ* Bern. (7)

SUBFAMILY DIASPINÆ.

29. *Chionaspis americana* Johnson. Collected in Audubon Park on Hickory and Celtis. T. C. B. Det. E. R. S.
30. *C. citri* Comst. (1)
31. *C. longiloba* Cooley. Collected in Audubon Park on Cottonwood. T. C. B. Det. E. R. S.
32. *C. salicis-nigra* Walsh. Collected in Audubon Park on Willow. T. C. B. Det. E. R. S.
33. *Diaspis boisduvalis* Sign. (7)
34. *D. bromeliæ* Kern. (7)
35. *D. echinocacti cacti* Comst. (4) Collected in Gretna, La., by C. W. Flynn, on Cactus. Det. Wilmon Newell.
36. *Aulacaspis pentagona* Targ. (5)
37. *A. rosæ* Bouche. (2 & 5)
38. *Fiorinia fioriniæ* Targ. var. *camelliæ*. (2 & 5)
39. *Aspidiotus ancylus* Putn. (5)
40. *A. brittanicus* Newst. (5)
41. *A. camelliæ* Sign. (7)
42. *A. forbesi* Johnson. (5)
43. *A. hederæ* Vall. (*A. nerii*, 1 & 2) (7)
44. *A. juglans regiæ* Comst. (2 & 5)
45. *A. lantaniæ* Sign. (4 & 7)
46. *A. ostreæformis* Curt. (5)
47. *A. perniciosus* Comst. (5 & 7)
48. *A. rapax* Comst. (2)
49. *Cryptophyllaspis liquidambaris* Kot. (7)
50. *Chrysomphalus aonidum* Linn. (*Aspidiotus ficus*, 1 *C. ficus*, 5 & 7)
51. *C. aurantii* Mask. Collected in Audubon Park on *Podocarpus japonica*. T. C. B. Det. E. R. S.
52. *C. dictyospermi* Morg. (4 & 7)
53. *C. obscurus* Comst. (5, 6 & 7)
54. *C. sphærioides* Ckll. (3)
55. *C. tenebricosus* Comst. (5)
56. *Odonaspis inusitata* Green. (7)
57. *O. secreta* Ckll. Collected in Audubon Park on Bamboo. T. C. B. Det. E. R. S.
58. *O.* sp. (7)
59. *Lepidosaphes beckii* Newm. (*Mytilaspis citricola*, 1 & 2.) (*L. beckii*, 5 & 7)
60. *L. gloveri* Pack. (*Mytilaspis gloveri* 1 & 2.) (*L. gloveri*, 5 & 7)
61. *Ischnaspis longirostris* Sign. (7)
62. *Parlatoria pergandei* Comst. (2, 5 & 7)
63. *P. proteus* Curt. (5 & 7)

NOTE:—Since the above was written, the following additional species have been collected in Audubon Park by the writer, and have been determined by Mr. E. R. Sasscer.

64. *Eriococcus quercus* Comst. On oak.
65 *Eulecanium caryæ* Fitch On oak.

Kermes galliformis Riley was also collected upon live oak, making a total of 49 species collected to date in Audubon Park.

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HOSTS AND GALLS OF AMERICAN GALL MIDGES

By E. P. Felt, *Albany, N. Y.*

The following list summarizes our knowledge concerning the food habits of the American gall midges or Itonidæ (including certain St. Vincent and other South American forms studied by the writer) and, in connection with the description of species, has proved of great help in determining many representatives of our rich and varied fauna. This list should also prove of service in indicating the more profitable lines for future life history and ecological studies in this group. It will be noted that our knowledge of the midges occurring upon certain plants is much more extensive than that in relation to others. A portion of this discrepancy is evidently due to marked preferences on the part of the insects, while in not a few cases it may be attributed to a lack of study. This is particularly true of the root-inhabiting forms. Potentially, there should be at least one, and frequently several species living at the expense of most of our native plants, while European forms may be introduced from time to time and become well established upon their natural hosts in this country.

This list gives the correct generic reference for the reared species so far as possible. The old generic name of Cecidomyia, with its varied interpretations by earlier writers, is used in this list as a designation for a biological group and applied to species we are unable to refer to any of the more closely defined, modern genera.

Abies balsamea (balsam)

Subglobular basal swellings of leaves, length 3 mm. . .*Cecidomyia balsamicola* Lintn.

ABIES (spruce)

Seeds destroyed, the cone not deformed. . . . . *Dasyneura canadensis* Felt.

ACALYPHA VIRGINICA (3-spotted mercury)

Subglobular, reddish bud gall, diameter 4 mm. . . . . *Cecidomyia* sp.

ACER (maple)

Rolled leaf margin, edges yellow, center crimson. . . . . *Cecidomyia* sp.

ACER NEGUNDO (box elder)

Terminal bud galls, diameter 1 to 2 cm. . . . . *Cecidomyia negundinis* Gill.
Variable, subglobose leaf gall, diameter about 2 mm. . . *Contarinia negundifolia* Felt.

ACER RUBRUM (red maple)

Under decaying bark . . . . *Miastor americana* Felt.
Lestodiplosis sp.
Ocellate, yellow, red margined gall, diameter 5–6 mm. . . *Cecidomyia ocellaris* O. S.
Distorted, rolled leaves bearing white cocoons. . . . . *Dasyneura* sp.
Lestodiplosis sp.
Irregular leaf folds. . . . . *Rhabdophaga rileyana* Felt.
Pouch vein galls, reddish, length 6 mm. . . . . *Dasyneura communis* n. sp.

ACER SACCHARINUM (white or silver maple)

Free larvæ on irregularly curled leaves. . . . . *Cecidomyia aceris* Shim.

ACHILLEA MILLEFOLIUM (Yarrow)

Florets infested. . . . . *Clinorhyncha millefolii* Wachtl.

ACTINOMERIS ALTERNIFOLIA

Globose bud galls. . . . . *Cecidomyia verbesinæ* Beutm.

AGRIMONIA (Agrimony)

Reared from florets. . . . . *Contarinia agrimoniæ* Felt.

AGROPYRON (quack)

Under leaf sheath. . . . . *Phytophaga destructor* Say.

AGROSTIS ALBA (red top)

Ovipositing on. . . . . *Dasyneura graminis* Felt.

ALNUS (alder)

Subconical bud gall, diameter 6 to 12 mm. . . . . *Dasyneura serrulatæ* O. S.

ALOPECURUS PRATENSIS (fox-tail grass)

Reared from seeds. . . . . *Itonida setariæ* Felt.

AMBROSIA (ragweed)

Reared from stems of giant ragweed. . . . . *Neolasioptera ambrosiæ* Felt.

AMELANCHIER (shadbush)

Truncate leaf gall, greenish, tapering, red-lipped, length 5 mm. *Hormomyia canadensis* Felt.
Oval, woolly, vein gall, yellowish or white, length 1 to 1.5 cm. *Itonida canadensis* n. sp.
Flattened, white pouch gall on leaf margin, denticulate, length 3 to 4 mm. *Cecidomyia* sp.
Leaf fold containing white larvæ................. ....*Cecidomyia* sp.

AMPHICARPA MONOICA (hog peanut)

Oval stem gall, length, 1.5 cm. diameter, 1 cm...... ....*Lasioptera* sp.

AMSINCKIA LYCOPSOIDES

Undescribed, presumably bud gall.. ....*Schizomyia macrofila* Felt.

ANEMONE CANADENSIS

Slightly enlarged, loose bud gall.. ....*Dasyneura anemone* Felt.

ANTENNARIA (everlasting)

Corm-shaped bud gall, leaflets recurved, length, 8 to 12 mm. *Asphondylia antennariæ* Whlr.
Elongate, oval bud gall, leaflets scarcely recurved, length 3 to 5 mm. *Rhopalomyia antennariæ* Whlr.
White, wooly masses, snow-white fibers, 5 mm. long, radiating from hard, thin shelled cells presumably on Antennaria... ....*Rhopalomyia pilosa* Felt.

ANTHEMIS (Mayweed)

Larvæ in flower heads.................. ....*Cecidomyia* sp.

APOCYNUM (spreading dogbane)

Reared from slightly enlarged flower buds...............*Itonida apocyni* Felt.
Reared from unopened flower buds.............*Lestodiplosis apocynifloræ* Felt.

ARCTIUM (burdock)

Yellowish larvæ in burs.............. ....*Cecidomyia* sp.

ARISTOLOCHIA (Dutchman's pipe)

Ovate leaf galls........................... ....*Cecidomyia hageni* Aldr.

ARTEMISIA (wormwood)

Bud galls, presumably............................*Asphondylia artemisiæ* Felt.
Flower galls or fusiform bud galls, length 4 mm.......*Rhopalomyia betheliana* Ckll.
Deformed flower heads, length 10 mm., diameter 5 to 6 mm. *Rhopalomyia coloradella* Ckll.
Globular, woolly galls, diameter about 1 cm.......... *Rhopalomyia alticola* Ckll.

ARTEMISIA TRIDENTATA (sage bush)

Subglobular, brown, spongy apical gall, diameter 1.8 cm...........*Cecidomyia* sp.
Probably stem gall.............................*Diarthronomyia artemisiæ* Felt.
Oval, bud-like, flower gall the size of a pea.........*Rhopalomyia tridentatæ* Rubs.

ARTEMISIA GNAPHALODES

Irregular, lobulate, polythalamous, white, pubescent gall, diameter 1 cm.
Rhopalomyia gnaphalodis n. sp.

ASCLEPIAS (milkweed)

Elongate, fusiform stem gall on *A. incarnata*............*Neolasioptera asclepiæ* Felt.
Rusty brown, irregularly swollen young leaves on *A. incarnata*.....*Cecidomyia* sp.
Oval, mid rib, tumid fold, length 7 mm. dia. 4 mm. on *A. incarnata*..*Cecidomyia* sp.
Reared from rolled leaf, *A. syriaca*...................*Lestodiplosis asclepiæ* Felt.

ASTER

Flower or Bud Galls

Aborted flower head of *Aster patens*..................*Asphondylia monacha* O. S.
Dwarfed or stunted flower heads of *Aster paniculatus*..*Rhopalomyia asterifloræ* Felt.
Axillary bud galls of *Aster lateriflorus*, diameter, 10 mm..*Rhopalomyia lateriflori* Felt.

Blister Leaf Galls

Gall, yellowish white, nearly circular, 2 to 3 mm. in diameter; on *Aster macrophyllus*.
Lasioptera clarkei Felt.
Gall, yellowish brown, narrowly oval, length, 4 mm.; diameter, 2 mm.
Asteromyia dumosæ Felt.
Gall, brownish, yellow ringed, circular, diameter, 3 mm.....*Asteromyia waldorfi* Felt.
Gall, yellowish, shining, oval, diameter, 6 to 7 mm..........*Asteromyia nitida* Felt.
Gall, pinkish, large, oval blotches on *Aster divaricatus*, diameter 10 to 12 mm.
Asteromyia divaricata Felt.
Gall, yellowish or brownish, irregularly oval, diameter 3 mm.
Asteromyia marginata Felt.
Gall, yellowish or brownish, irregularly oval, diameter 6 mm.; on *Aster paniculata*.
Asteromyia paniculata Felt.
Gall, blackish, oval, diameter 4 mm...................*Asteromyia reducta* n. sp.
Gall, greenish yellow or papery white, diameter 1.75 cm.; on *Aster lævis*
Asteromyia læviana Felt.
Gall, sooty yellow beneath, dirty white above, length, 2 cm.; diameter, 1.2 cm.
Asteromyia flavomaculata Felt.
Gall, yellowish white, dark margined, diameter, 3.0 mm *Asteromyia asterifolia* Beutm.
Gall, oval, green swellings, length 2 mm., diameter, 1.5 mm.
Asteromyia vesiculosa Felt.

Stem or Branch Galls

Gall, a small pustulate swelling on aster stems, diameter 3 mm.
Asteromyia pustulata Felt.
Fusiform stem or branch gall, length, 1 cm.; diameter 0.4 cm.
Neolasioptera ramuscula Beutm.
Greenish brown, fusiform, irregular stem swelling at or near the base of the leaf, length, 1 cm; diameter, 0.6 cm., on *Aster infirmus*... *Neolasioptera albitarsis* Felt.
Oval twig gall on *Aster novæ-angliæ*..................*Rhopalomyia astericaulis* Felt.
Ovate, sessile, brownish galls densely white haired, length, 7 mm., on *Aster crassulus*.
Rhopalomyia crassulina Ckll.

ATRIPLEX CANESCENS

Irregular stem gall, length, 12 mm.; diameter, 4.5 to 6 mm. *Asphondylia atriplicis* Ckll.
Irregularly subglobular with sparse, long hairs, diameter, 8 to 9 mm. *Asphondylia neomexicana* Ckll.
Irregular twig gall, length, 1.5 mm.; diameter, 5 mm.....*Lasioptera willistoni* Ckll.
A circular, pustular leaf gall, diameter, 2.5 mm.......*Cecidomyia atriplicicola* Ckll.

AUDIBERTIA STACHYOIDES

Irregular, subspheric gall.........................*Rhopalomyia audibertiæ* Felt.

AVENA (oat)

Reared from cage with aphid-infested seedlings, probably zoöphagous *Coquillettomyia texana* Felt.
Reared from oats, possible fungivorous..............*Mycodiplosis spinosa* n. sp.
Reared from cage sown with oats.....................*Prionellus monilis* Felt.

BACCHARIS PILULARIS

Flower gall...................................*Rhopalomyia californica* Felt.
Lobulate bud gall..*Rhopalomyia* sp.
Stem gall.....................................*Rhopalomyia baccharis* Felt.

BENZOIN (spice bush)

Young leaves with margins rolled..............................*Cecidomyia* sp.
Irregular subcortical gall, length, 2 to 0.5 cm.............*Lasioptera linderæ* Beutm.

BETULA (birch)

Under decaying bark...................................*Miastor americana* Felt.
Lestodiplosis sp.
Reared from seeds.....................................*Oligotrophus betulæ* Winn.

BIGELOWIA (rayless goldenrod)

A small, bud-like gall on *B. graveolens*............*Cecidomyia brassicoides* Town.
Cone-like, probably bud gall on *B. graveolens*.......*Dasyneura strobiloides* Town.
Oval seed gall................................*Rhopalomyia bigelovioides* Felt.
Hollow stem gall..............................*Rhopalomyia bigeloviæ* Ckll.

BOEHMERIA (false nettle)

Fusiform stem gall, length, 12 mm.; diameter, 6 mm....*Cecidomyia bœhmeriæ* Beutm.

BUMELIA (false buckthorn)

Probably bud galls on *B. lanuginosa*................*Asphondylia bumeliæ* Felt.

BUXUS (box)

Oval, yellowish or brownish blister-leaf gall..........*Monarthropalpus buxi* Lab.

CARPINUS (hornbeam, ironwood)

Reddish leaf fold along lateral veins.................*Cecidomyia pudibunda* O. S.

CARYA (hickory)

Under decaying bark . . . . *Miastor americana* Felt.
Under dying, sappy bark . . . . *Cecidomyia* sp.

Leaf Galls

Blister galls.—Irregular, dull greenish or black-margined and with a small nipple, diameter, 3 mm . . . . *Cecidomyia* sp.

Cylindric galls.—Greenish or black, 4 to 5 mm. long, 1 mm. in diameter. *Caryomyia tubicola* O. S.

Conical galls.—Base subglobular with a long, slender apical process, greenish to reddish brown, 3 to 4 mm. long. Occurs in groups on midrib of bitternut hickory . . . . *Caryomyia caryæcola* O.S.

Conical, nearly symmetrical, thin-walled, small, green or red tinted, length, 2 mm . . . . *Caryomyia sanguinolenta* O. S.

Narrowly conical, light green midrib or vein gall, length, 5 mm., diameter, 1 mm . . . . *Caryomyia* sp.

Globose galls.—Smooth or nearly so.

Nearly smooth, thin-walled yellowish green or brown, sparsely haired, usually with a slight nipple, diameter, 2 mm . . . . *Caryomyia caryæ* O. S.

From same gall, probably inquiline . . . . *Cecidomyia caryæ* O. S.

Slightly pubescent, thick-walled, depressed, yellowish green or brown, diameter, 2 to 2.5 mm . . . . *Caryomyia consobrina* Felt.[1]

Thin-walled, probably similar to the above . . . . *Caryomyia arcuaria* Felt.

Thin-walled without the nipple of *Caryomyia caryæ*, with a yellowish pubescence, diameter, 2 to 4 mm . . . . *Caryomyia similis* Felt.

Thin-walled, globose, slightly depressed, with a slight nipple, diameter, 3 to 4 mm . . . . *Cecidomyia* sp.

Thick-walled, yellowish green or brown, diameter, 4 to 5 mm. *Caryomyia antennata* Felt.

Thick-walled, irregularly ovate, granulate, a slight nipple, diameter, 2 to 3 mm. *Cecidomyia* sp.

Thin-walled with a false chamber at the apex, diameter, 2 to 3 mm. *Caryomyia inanis* Felt.

Globose galls.—Hairy.

Thick-walled, brown or reddish brown, hairs rather short, curly, thick, diameter, 6 to 7 mm . . . . *Caryomyia persicoides* Beutm.

Similar to the above and other Caryomyia galls, probably inquiline *Clinodiplosis caryæ* Felt.[2]

Thin-walled, rust red, hairs rather long, straight, diameter, 2 to 4 mm. *Caryomyia holotricha* O. S.

Gall, similar to the above, the midge probably inquiline *Mycodiplosis holotricha* Felt.

Thin-walled, long haired, melon-shaped, diameter, 2 to 3 mm. *Caryomyia thompsoni* Felt.

Thin-walled, long, thick, brown hair, globose, diameter, 3 to 4 mm.; nipple distinct, long on some . . . . *Caryomyia* sp.

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[1] *Schizomyia caryæcola* Felt was supposed to have been reared from this gall. The one or two specimens obtained were probably accidental.

[2] This species was apparently reared from the gall of *Caryomia inanis* and that of *C. persicoides*, probably *inquiline*.

Midrib gall.—A rounded, irregular, pale yellowish, hard swelling, 12 mm. long. *Caryomyia cynipsea*[3] O. S.

Forming no gall.—An irregular, yellowish brown margined elevation; diameter, 3 mm. Larva attached by a viscid secretion... ....*Caryomyia glutinosa*[3] O. S.

Swellings in Husks

Irregular swelling in the husks produced by pale reddish larvæ. *Caryomyia nucicola*[3] O. S.

CASSIA (wild sensitive plant)

Irregular stem gall, length, 3 cm; diameter, 5 or 6 mm.. ...*Lasioptera cassiæ* Felt.

CASSAVA (Manihot)

Leaf galls......... .... *Itonida manihot* Felt.

CASTANEA (chestnut)

Under decaying bark and wood . ...*Miastor americana* Felt.
Winnertzia pectinata, n. sp.
Itonida pugionis n. sp.

Petiole or terminal bud gall.. ... ...*Rhopalomyia castaneæ* Felt.

CASTANEA PUMILA (Chinquapin)

Irregular swelling of bur........................*Cecidomyia chinquapin* Beutm.

CATALPA

Reared from dwarfed shoots and pods. .... *Itonida catalpæ* Comst.

CATTLEYA GIGAS

Reared from roots............. ....*Clinodiplosis cattleyæ* Felt.

CEANOTHUS

Loose terminal bud gall, length, 2 cm.; diameter, 1.5 cm. *Asphondylia ceanothi* Felt.

CELASTRUS (climbing bittersweet)

Irregular, cortical gall on root, length, 2.5 cm.; diameter, 1 cm. *Cecidomyia celastri* Steb.

Subcortical stem gall probably identical.

CELTIS (hackberry)

Galls on tender twigs, resembling seed capsule of Rumex, length, 4.5 mm. *Cecidomyia* sp. (*semenrumicis* Patt.)

Conical or subglobular, arising from a circular, truncate base, diameter, 3.4 mm.; on tender twigs..........................*Cecidomyia* sp. (*oviformis* Patt.)

Hollow, elongate twig swellings, length, 1.25 to 2.5 cm...*Cecidomyia* sp. (*deserta* Patt.)

A hard, obconic gall on upper side of leaf ....*Phytophaga celtiphyllia* Felt.

Subconical, clustered on the under side of the leaves, length, 3 to 5 mm. *Cecidomyia unguicula* Beutm.

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[3] The reference of this larva to Caryomyia is provisional only.

Rosette-shaped gall, resembling the seed capsule of Hibiscus, diameter, 2 to 3 mm. on under side of leaf .... *Cecidomyia* sp. (*capsularis* Patt.)
Yellowish, disk-shaped gall with acute apical cone on leaf ... *Cecidomyia lituus* Walsh.
Leaf gall resembling that of *Pachypsylla celtidis-pubescens*, diameter, 3.5 to 4 mm. *Cecidomyia* sp. (*pubescens* Patt.)
Stout, conical, arising from a circular base, yellowish, diameter, 2.8 mm. *Cecidomyia* sp. (*spiniformis* Patt.)

CEPHALANTHUS (button bush)

Twig gall .... *Rhabdophaga cephalanthi* Felt.

CHRYSOPSIS (golden aster)

Woolly, polythalamous bud gall, diameter, 1.5 cm ... *Rhopalomyia chrysopsidis* Loew.

CICUTA (water hemlock)

White larva, probably on leaves .... *Cecidomyia* sp.

CIRSIUM (Canada thistle)

Reared from flower heads .... *Dasyneura gibsoni* n. sp.

CITHAREXYLUM

Reared from flowers ... . *Asphondylia pattersoni* Felt.

CLEMATIS (virgin's bower)

Ovate, reddish brown, axillary gall, diameter, 4 mm .. *Neolasioptera clematidis* Felt.
Iregular, subglobular bud gall, diameter, 1 cm .... *Dasyneura clematidis* Felt.
Irregular, subglobular bud gall, diameter, 1 cm .... *Contarinia clematidis* Felt.
Enlarged, reddened flower buds .... *Prodiplosis floricola* Felt.
Unopened, apparently normal flowers .... *Lestodiplosis clematiflorœ* Felt.

CLERODENDRON ACULEATUM (wild coffee)

Flower bud gall .... *Asphondylia attenuatata* Felt.

COFFEA (Liberean coffee tree)

Reared from fruits ... . *Hyperdiplosis coffeœ* Felt.

COLLINSONIA (horse balm)

Subglobular, pubescent leaf gall, length, 4 to 7 mm. *Cecidomyia collinsoniœ* Beutm.
Narrow midrib or vein swelling .... *Cecidomyia collinsonifolia* Beutm.

CONVOLVULUS SEPIUM (hedge bindweed)

Fusiform stem gall, monothalamous, length, 1.5 cm .... *Lasioptera convolvuli* Felt.

CORNUS (dogwood)

Irregular, subcortical gall, length, 1 to 2 cm.; on *C. stolonifera* *Neolasioptera cornicola* Beutm.
Clavate twig gall, length, 1 to 2 cm.; on *C. florida* .... *Lasioptera clavula* Beutm.
Yellowish, purple margined, blister leaf gall, diameter, 2 to 3 mm.; on *C. stolonifera*. *Lasioptera corni* Felt.
Tubular, curved, green gall, length, 8 mm.; on leaf of *C. amomum*. *Cecidomyia* sp. (*tuba* Steb.)

CORYLUS (hazel nut)

Hairy leaf fold..*Lasiopteryx coryli* Felt.
Reared from same gall.................. ....*Mycodiplosis corylifolia* Felt.
Sterile catkins deformed basally, swollen. . ....*Cecidomyia* sp. (*squamulicola* Steb.

CRATÆGUS (white thorn)

Reddish brown or green, blister leaf mine, diameter, 8 mm.
Lasioptera excavata Felt.
Reared from the same gall... ....*Rhizomyia hirta* n. sp.
Cylindric, green, fimbriate, unicellular leaf gall, length, 4 to 5 mm.; height, 1.5 mm.
Rhizomyia absobrina Felt.
Reared from same gall..........................*Lestodiplosis cratægifolia* Felt.
Stout, cup-shaped, fimbriate, unicellular leaf gall......*Winnertzia hudsonici* Felt.
Cockscomb leaf gall, green and red, length, 1 cm....*Hormomyia cratægifolia* Felt.
Filamentous, subglobular vein gall, length, 1 cm......*Cecidomyia bedeguar* Walsh.
Oval, fleshy vein gall, length, 5 to 8 mm............*Cecidomyia* sp. (*venæ* Steb.)
Marginal leaf roll...............................*Lestodiplosis florida* Felt.

CROTALARIA (rattle box)

Fusiform stem swelling........................*Cecidomyia* sp. (*crotalariæ* Steb.)

CUCUMERIS (melon)

Reared from curled tips ....*Contarinia setigera* Lintn.

CUCURBITA (squash)

Reared from rough squash........................ *Mycodiplosis cucurbitæ* n. sp.
Reared from rough squash.............................*Itonida cucurbitæ* n. sp.

DANTHONIA (wild oat grass)

Probably a stem gall................................*Lasioptera danthoniæ* Felt.

DESMODIUM (tick trefoil)

Bud gall, probably loose......................*Cecidomyia meibomiifoliæ* Beutm.
Elongate, fusiform, clustered bud gall, length, 8 to 22 mm.
Cecidomyia meibomiæ Beutm.
Irregular stem gall, length, 1.8 cm...................*Lasioptera desmodii* Felt.
Polythalamous stem gall, length, 2 cm................*Neolasioptera hamata* Felt.

DIERVILLA (bush honeysuckle)

Green bud gall or enlarged fruit, length, 4 to 5 mm...*Asphondylia diervillæ* Felt.
Reared from apparently normal stem, diameter, 3 to 4 mm.
Lasioptera caulicola Felt.

DISCOREA (Yam)

Irregular, warty stem gall...*Cecidomyia* sp.

ELYMUS AMERICANUS (wild rye)

Probably from stem gall.............................*Rhabdophaga elymi* Felt.
Stem gall...*Phytophaga destructor* Say.

EPHEDRA TRIFURCA

Irregular, subcortical, resinous gall..................*Lasioptera ephedricola* Ckll.
Fusiform twig gall, length, 12 mm.....................*Lasioptera ephedræ* Ckll.

ERAGROSTIS MINOR

Probably a stem gall ....*Neolasioptera agrostis* n. sp.

ERIGERON CANADENSIS (horseweed)

Reared from minute bud galls usually and also from a scarcely discolored, inconspicuous, blister mine... ....*Asteromyia modesta* Felt.
Fusiform stem gall..... .. ..*Neolasioptera erigerontis* Felt.

ERIOGONUM

Elongate bud swelling ... ...*Cecidomyia* sp.

EUPATORIUM

Green conical leaf galls, length, 4 mm.; diameter, 1.5 mm.
Hyperdiplosis eupatorii Felt.

EUPATORIUM PERFOLIATUM (thoroughwort, boneset)

Reared from apparently normal florets . ...*Clinorhyncha eupatoriflorœ* Felt.
Reared from florets...... ... .*Contarinia perfoliata* Felt.
Oval stem gall, length, 1 to 1.5 cm........ ....*Neolasioptera perfoliata* Felt.
Reared from apparently the same gall....... ....*Brachyneura eupatorii* Felt.

EUPATORIUM PURPUREUM (Joe-pyeweed, trumpetweed)

Oval, blossom bud gall, length, 1 cm..................*Dasyneura purpurea* Felt.

EUPATORIUM URTICÆFOLIUM (white snake root)

Globose, flower, bud galls, length, 6 mm....... ......*Lestodiplosis eupatorii* Felt.
Subglobular stem gall, length, 1.5 cm. ....*Neolasioptera eupatorii* Felt.
Similar gall.................. .... *Asphondylia eupatorii* n. sp.

EUPHORBIA (spurge)

Subcylindric fruit gall, length, 5 mm.; diameter, 1 mm.. ... .*Cecidomyia* sp.

EUROTIA

Irregular bud galls...... ... .*Cecidomyia* sp.

FAGUS (beech)

Under decaying bark ....*Miastor americana* Felt.

FICUS (wild fig)

Reared from a decaying branch. ....*Holoneurus occidentalis* Felt.
Lasiopteryx schwarzi Felt.
Hyperdiplosis americana Felt.

FRAGARIA (strawberry)

Reniform petiole gall, length, 8 to 21 mm......*Cecidomyia* sp. (*reniformis* Steb.)

FRAXINUS (ash)

Subglobular leaf galls, diameter, 5 mm................*Lasioptera fraxinifolia* Felt.
Same gall as above............... ....*Cecidomyia pellex* O. S.
Apparently from the same gall........................*Colpodia temeritatis* Felt.
Large, tumid, midrib gall, length 5 to 15 mm........... *Contarinia canadensis* Felt.
Same gall as above.. ....*Dasyneura tumidosœ* Felt.

Base of leaf petioles .... *Phytophaga fraxini* Felt.
Badly rolled leaves .... *Lestodiplosis fraxinifolia* Felt.
Badly rolled leaves.......... *Rhizomyia fraxinifolia* Felt.
Tightly rolled leaves.......... *Dasyneura fraxinifolia* Felt.
Deformed terminal leafy head.......... *Dasyneura apicatus* Felt.

FUNGI

Fungus on rotting plum .... *Hyperdiplosis fungicola* n. sp.
Unknown fungus.......... *Arthrocnodax macrofila* Felt.
Æcidiospores of Urocymes.......... *Toxomyia rubida* Felt.
Teleutospores of Puccinia.......... *Toxomyia fungicola* Felt.
Young mushrooms.......... *Mycophila fungicola* Felt.
Reared from *Œcidium impatientis*.......... *Mycodiplosis impatientis* Felt.
Larvæ on *Œcidium importatum* affecting Peltandra.......... *Mycodiplosis* sp.
Fungous affected wood.......... *Lasiopteryx flavotibialis* Felt.
Fungous affected heartwood of pine.......... *Monardia lignivora* Felt.

GALIUM (bedstraw)

Aborted flower buds, diameter, 3 mm.......... *Dasyneura galii* Felt.

GALEOPSIS (hemp nettle)

Irregular stem gall, length, 0.5 to 2 cm.......... *Lasioptera galeopsidis* Felt.

GARRYA FREMONTII

Suboval, black, irregular bud gall.......... *Asphondylia* sp.

GENISTA (woad-waxen)

Folded apical leaflets..........(?) *Dasyneura genistamtorquens* Kieff.

GERANIUM (cranesbill)

Colorless larvæ on blister enlargement, apparently fungivorous.. *Cecidomyia* sp.

GERADIA FLAVA (downy false fox-glove)

Larvæ in seed pods .... *Cecidomyia* sp.

GLEDITSIA (honey locust)

Orange larvæ in folded leaflets.......... *Dasyneura gleditschiæ* O. S.
Twig gall undescribed.......... *Neolasioptera* sp.

GOSSYPIUM (cotton)

Reared from flower buds.......... *Contarinia gossypii* Felt.

GRAMINEÆ (grass)

Reared from grass.......... *Neolasioptera squamosa* n. sp.

GUTIERREZIA SAROTHRÆ

Oval flower bud gall, length, 7 mm.......... *Rhopalomyia gutierreziæ* Ckll.

HAMAMELIS (witch-hazel)

Greenish blister leaf gall.......... *Asteromyia nigrina* n. sp.
Purplish, blister leaf galls, diameter, 5 mm.......... *Cecidomyia* sp.
Fleshy vein folds, length, 2 cm.......... *Cecidomyia* sp.
Purplish, corrugated folds between veins.......... *Cecidomyia* sp.

HELENIUM (sneeze weed)

Apical rosette gall, length, 2 to 3 cm.............. *Asphondylia autumnalis* Beutm.

HELIANTHUS (sunflower)

Sunflower seeds apparently normal............. *Lasioptera murtfeldtiana* Felt.
Twig gall, undescribed............................ *Asphondylia conspicua* O. S.
Globular or spherical stem galls, diameter, 1 to 4 cm....... *Asphondylia globulus* O. S.
Stem gall, undescribed............................ *Neolasioptera trimera* n. sp.
Stem gall on *H. divaricata*...................... *Cecidomyia thurstoni* Brodie.
Fusiform stem gall, length, 3 mm.......... .... *Lasioptera weldi* Felt.
Subglobular leaf gall.......................... ..... *Cecidomyia bulla* Walsh.

HELIANTHUS STRUMOSUS

Flower heads apparently unmodified............. *Asphondylia helianthifloræ* Felt.
Reared from undetected gall. .... *Neolasioptera helianthi* Felt.
Axillary bud gall, length, 10 to 25 mm.... .... *Cecidomyia helianthi* Brodie.

HIBISCUS MOSCHEUTOS (swamp rose mallow)

Variably swollen stems............................ *Neolasioptera hibisci* Felt.

HORDEUM (barley)

Under leaf sheaths.. ... . *Phytophaga destructor* Say.

HUMULUS (hop)

Swollen stems, diameter, 1 cm.; length, 4 to 50 cm...... *Lasioptera humulicaulis* Felt.

HYDRANGEA ARBORESCENS (wild Hydrangea)

Bud gall, length, 1 cm .... *Asphondylia hydrangeæ* Felt.

HYPERICUM (St. Johnswort)

Axillary bud galls, length, 5 mm.; on *H. mutilum*......... *Dasyneura toweri* Felt.
Subglobose stem gall, length, 1 cm.................. *Lasioptera virginica* n. sp.
Globular stalk swellings, length, 6 to 10 mm........... *Cecidomyia triadenii* Beutm.

IMPATIENS (balsam, jewelweed)

Globose, flower bud gall, length, 1 cm............. *Cecidomyia impatientis* O. S.
Tumid midrib fold, length, 5 mm................ *Lasioptera impatientifolia* Felt.
Subglobular stem gall........................... .. *Lasioptera fulva* Beutm.

IPOMOEA (morning glory)

Flower buds.......... .... *Schizomyia ipomϾ* Felt.
Flower buds.................... .... *Camptoneuromyia meridionalis* Felt.

JUGLANS CINEREA (butternut, white walnut)

Folded, appressed, crinkled leaves... .... *Cecidomyia* sp.

JUNIPERUS CALIFORNICA (Juniper)

Reared from fruit.............................. *Walshomyia juniperina* Felt.

JUSSIÆA

Reared from fruits................................. *Asphondylia vincenti* Felt.

LACTUCA (wild lettuce)

Irregular stem gall, diameter, 1.75 cm.................. *Lasioptera lactucæ* Felt.

LAPORTEA (wood nettle)

Irregular, oval stem gall.. *Cecidomyia* sp.
Irregular, probably bud gall, length, 1.2 cm.......................... *Cecidomyia* sp.

LARREA (creosote bush)

Gall undescribed................................ *Asphondylia auripila* Felt.

LATHYRUS MARITIMUS (beach pea)

Rolled leaflets, length, 1 to 2 cm...................... *Dasyneura maritima* Felt.

LEPIDIUM (pepper grass)

Swollen, discolored seed capsules....................... *Dasyneura lepidii* Felt.

LESPEDEZA VIOLACEA

Stem gall, length, 5 mm.; diameter, 3 mm........................ *Cecidomyia* sp.

LILIUM SUPERBUM (lily)

Larvæ on leaves................................ *Mycodiplosis carolina* n. sp.

LIRIODENDRON (tulip tree)

Purplish, blister gall on leaf..................... *Thecodiplosis liriodendri* O. S.
Midrib, polythalamous leaf gall, length, 1.5 cm........ *Cecidomyia tulipiferæ* O. S.
Globular, midrib or vein gall, monothalamous, length, 5 mm...... *Cecidomyia* sp.

LUPINUS (Lupine)

Reared from undescribed gall........................... *Lasioptera lupini* Felt.
Reared from leaflets................................. *Dasyneura trifolii* Loew.

LYCOPERSICUM ESCULENTUM (tomato)

Reared from flowers............................. *Contarinia lycopersici* Felt.

LYCOPUS (bugle weed)

Subglobular stem gall, length, 8 to 10 mm................. *Lasioptera lycopi* Felt.
Fusiform stem gall, length, 1.5 to 2 cm................ *Lasioptera mitchellæ* Felt.

LYSIMACHIA (loose strife)

Loose, apical bud gall......................... *Dasyneura lysimachiæ* Beutm.
Gall undetected, possibly from vegetable matter....... *Lestremia solidaginis* Felt.

MAIANTHEMUM (false lily-of-the-valley)

Blister gall, brown, diameter, 6 mm.............................. *Cecidomyia* sp.

MANIHOT (Cassava)

Leaf galls.. *Itonida manihot* Felt.

MANGIFERA (mango)

Reared from subcortical gall........................ *Asynapta mangiferæ* Felt.

MEDICAGO (alfalfa)

Seed pods of alfalfa.. *Asphondylia* sp.

MENTHA (mint)

Axillary or terminal bud gall, length, 4 mm.... ....*Dasyneura aromaticæ* Felt.
Terminal bud gall, length, 3 mm.; on *M. gentilis*.................*Cecidomyia* sp.
Loose, bud gall, length, 3 mm.; on *M. piperita*... .....*Dasyneura piperitæ* Felt.
Pustulate gall in axil of leaf, diameter, 3.5 mm.; on *M. canadensis*.
Giardomyia menthæ Felt.
Polythalamous stem gall, length, 6 to 12 mm.........*Neolasioptera menthæ* Felt.

MENTZELIA

Reared from flower buds.........................*Asphondylia mentzeliæ* Ckll.

MIMULUS (monkey flower)

Stem gall undescribed.... .. ..*Neolasioptera mimuli* Felt.

MONARDA FISTULOSA (wild bergamot)

Variable stem gall, length, 10 to 22 mm.............*Cecidomyia monardi* Brodie.

MUHLENBERGIA

Fusiform stem enlargement.............. ....*Asteromyia agrostis* O. S.

MYRICA CERIFA (wax myrtle)

Bud galls......................................*Cecidomyia myricæ* Beutm.

MYRICA ASPLENIFOLIA (sweet fern)

Fleshy, vein folds, length, 2 to 4 mm................*Janetiella asplenifolia* Felt.

NEMOPANTHUS (mountain holly)

Oval bud gall, length, 5 mm.......................*Asphondylia ilicoides* Felt.

NYSSA (black or sour gum)

Marginal leaf fold, length, 2.5 to 3.5 mm...........*Cecidomyia nyssæcola* Beutm.
Twig gall, length, 4 to 5 cm.; diameter, 8 mm.................*Cecidomyia* sp.

OECIDIUM

Larvæ on *O. impatientis*.........................*Mycodiplosis impatientis* Felt.
Larvæ on *O. importatum*..................................*Mycodiplosis* sp.

OPUNTIA (Cactus)

Swollen fruit....................................*Asphondylia betheli* Ckll.
Very large, swollen fruit.... ....*Asphondylia arizonensis* Felt.
Gall undescribed.............................:...*Asphondylia opuntiæ* Felt.
Decayed spots at base of spines.......................*Itonida opuntiæ* Felt.

OSTRYA (hop hornbeam)

Terminal folded leaves...*Cecidomyia* sp.

OXYBAPHUS

Stem gall, length, 1.5 to 2 cm.....................*Lasioptera allioniæ* n. sp.

PACHISTIMA MYRSONITIS

Terminal leaves folded, dark red............................*Cecidomyia* sp.

PAEONIA (peony)

Decaying roots.......................... ....*Joanissia pennsylvanica* n. sp.

PANICUM (panic grass)

Ovipositing in stem....................................*Lasioptera panici* Felt.

PAPAVER (poppy)

Stem gall, undescribed.............................*Clinodiplosis caulicola* Coq.

PICEA (spruce)

Reared from seed.................................*Dasyneura canadensis* Felt.

PINUS (pine)

Apical, bud-like swelling, diameter, 1 cm.; on *P. scopulorum*.
Dicrodiplosis gillettei n. sp.
Globose swelling at base of needles; on *P. inops*....*Cecidomyia brachynteroides* O. S.
Resinous cocoons on needles............................*Cecidomyia inopis* O. S.
Aborted needle clusters, base subglobose; on *P. rigida*..*Cecidomyia pinirigidæ* Pack.
Similar needles on *P. edulis*.....................................*Cecidomyia* sp.
Base of needles of *P. radiata*..............*Thecodiplosis piniradiatæ* Snow & Mills.
Reared from extruded resinous masses on *P. rigida*........*Itonida resinicola* O. S.
Reared from extruded resinous masses on *P. radiata*......*Itonida resinicoloides* Wlms.
Reared from bark of *P. inops*.....................*Winnertzia pinicorticis* Felt.
Reared from Scolytid galleries in pine.................*Monardia pinicorticis* Felt.
Cecidomyia hopkinsi n. sp.
Reared from fungous affected heartwood, *P. rigida*........*Monardia lignivora* Felt.

PISONIA ACULEATA (Wait-a-bit)

Subconic stem gall.............................*Brugmanniella mexicana* n. sp.

PLANTAGO (plantain)

Gall undetected.......................................(?) *Lestodiplosis* sp.

PLATANUS (plane tree)

Reared from rolled leaves........................*Lestodiplosis platanifolia* Felt.

POA PRATENSIS (June grass)

Gall unrecognized..................................*Colpodia pratensis* Felt.

POLYGONATUM (Solomon's seal)

Blister gall, diameter, 4 mm...*Cecidomyia* sp.

POPULUS (poplar)

Irregular, monothalamous, blister leaf gall........*Cecidomyia* sp. (*irregularis* Steb.)
Subglobular leaf galls..............................*Rhizomyia absobrina* Felt.
Variable, subglobular leaf gall.........................*Dicrodiplosis populi* Felt.
Apparently the same gall.........................*Lestodiplosis globosus* Felt.
Subglobular leaf gall, diameter, 3 to 4 mm.............*Mycodiplosis populifolia* Felt.
Irregular, tumid gall at base of leaf, similar to that of *Lasioptera vitis*..*Cecidomyia* sp.
Marginal leaf roll, length, 1cm....................*Lestodiplosis populifolia* Felt.
Brown, marginal leaf roll, length, 2.5 cm., several larvæ..........*Cecidomyia* sp.

Longitudinal fold galls dwarfing leaf............................*Cecidomyia* sp.
Oval, white cocoons on twigs.........................*Rhabdophaga populi* Felt.
Irregular, subconical twig or petiole gall, length, 1 cm..............*Cecidomyia* sp.
Decaying wood....................................*Kronomyia populi* n. sp.

POPULUS CANDICANS (Balm of Gilead)

Roundly conic leaf gall, diameter, 3 mm.........................*Cecidomyia* sp.

PORTULACA OLERACEA

Stem gall ....*Lasioptera portulaccæ* Felt.

POTENTILLA (cinquefoil)

Internodal stem gall......................*Cecidomyia* sp. (*potentillæcaulis* Steb.)

PROSOPIS (mesquite)

Aborted fruit....................................*Asphondylia prosopsidis* Ckll.
Fusiform bud gall...*Cecidomyia* sp.

PRUNUS (CHERRY)

Swollen deformed fruit, *P. virginiana*................*Contarinia virginianiæ* Felt.
Swollen deformed fruit, *P. virginiana*..............*Parallelodiplosis acernea* Felt.
Swollen deformed fruit, *P. virginiana*..................*Itonida canadensis* n. sp.
Swollen deformed fruit, *P. virginiana*................*Arthrocnodax apiphila* Felt.[1]
Swollen deformed fruit, *P. virginiana*..........................*Lestodiplosis* sp.[1]
Apparently from same gall..........................*Rhizomyia absobrina* Felt.
Probably from same gall..........................*Cecidomyia cerasiphila* n. sp.
Swollen deformed fruit on wild cherry, *P.* ? *melanocarpa*..*Dasyneura pergandei* n. sp.
Elliptical, polythalamous gall on raceme axis, length, 27 mm., *P. virginiana*.
Cecidomyia sp. (*racemi* Steb.)
Irregular, thickened, folded leaf; on *P. virginiana*....*Mycodiplosis cerasifolia* Felt.
Terminal shoot and bud gall, diameter, 1.5 cm.; on *P. serotina*.
Cecidomyia serotinæ O. S.
Variable, oval or fusiform twig galls; on *P. serotina*..............*Cecidomyia* sp.
Lestodiplosis cerasi Felt.

PSEDRA (Virginia creeper)

Tumid rib gall, length, 1 cm...................................*Cecidomyia* sp.
Irregular root gall, 2 to 3mm.................................*Cecidomyia* sp.

PYRUS (pear)

Deformed young fruit............................*Contarinia pyrivora* Riley.

QUERCUS (oak)

Fruit

Reared from larvæ found between the seed coats of an acorn..*Dasyneura glandis* Felt.

Flower Galls

Reared from undescribed galls on blossoms of oak.......*Lasioptera quercifloræ* Felt.

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[1] Predaceous or scavenger.

Leaf Galls

Leaf edge galls.

Gall a folded leaf edge between serrations....... *Itonida foliora* Rssl. & Hkr.

Similar gall, possibly identical. .... *Cecidomyia erubescens* O. S.

Vein galls.

A narrow, dark purplish, fusiform, thin-walled swelling on the under side of the mid or lateral veins may contain two or more orange larvæ, length, 8 mm............................... *Cincticornia podagræ* Felt.

Gall very similar to, if not identical with the above... *Cincticornia majalis* O. S.

Elongate, pocket-like swellings along midrib of round-leaved scrub oak. *Clinodiplosis florida* Felt.

An elongate fold gall close to the midrib on the under surface, length, 12 mm.; diameter, 1 mm.; on *Quercus tinctoria*. .... *Cecidomyia oruca* Walsh.

A large midrib fold with a conspicuous white pubescence. *Cecidomyia niveipila* O. S.

Globose or subglobose, thickened, usually reddish, galls.

Reddish, oval, irregular, wrinkled leaf gall, diameter, 3 to 4 mm. *Cincticornia pilulæ* Walsh.

A similar gall, apparently Southern, possibly made by the same species. *Cincticornia symmetrica* O. S.

Gall similar to though much smaller than that of *Cincticornia pilulæ*. *Dasyneura florida* Felt.

Reared from oak, presumably from a gall resembling that made by Cynips. *Thecodiplosis quercifolia* Felt

A subhemispheric, brown, slightly nippled, monothalamous gall on the under side of the leaf, diameter, 1.75 mm............ *Cincticornia globosa* Felt.

Globular gall, diameter, 4 mm. on under side of running oak leaf. *Youngomyia quercina* n. sp.

Flattened, pustulate or blister galls.

A flat, relatively inconspicuous, probably blister gall.. *Cincticornia quercifolia* Felt.

A slight circular, blister-like swelling on the lateral veins, length, 3 mm., diameter, 1 mm.......................... *Cincticornia americana* Felt.

A broadly, yellow margined, circular, blister gall, diameter, 3 mm. *Cincticornia serrata* Felt.

A variable brown, irregularly oval, pustulate swelling, 5 to 6 mm. in diameter. *Cincticornia pustulata* Felt.

An irregularly oval, pustulate swelling, 5 to 6 mm. in diameter, showing equally on both surfaces but with no nipple........... *Cincticornia simpla* Felt.

Reared from a similar gall....................... *Cincticornia sobrina* Felt.

Probably reared from oak leaves................ *Dicrodiplosis quercina* Felt.

Twig Galls

Reared from twigs of white oak, *Quercus alba*.......... *Lasioptera querciperda* Felt.

Stems

Under decaying bark.................................. *Leptosyna querci* n. sp.
Miastor americana Felt.
Itonida cincta n. sp.

RHODODENDRON NUDIFLORUM (purple azalea)

Fusiform, brownish bud gall, length, 7 mm.............. *Asphondylia azaleæ* Felt.

RHUS (sumac)

Subglobular flower bud gall, diameter, 3 mm..... *Asphondylia integrifoliæ* Felt.
Stunted heads or curled leaves..................... *Arthrocnodax rhoina* Felt.
Subcortical stem gall..................................... *Cecidomyia* sp.
Globose root galls.................................. *Dasyneura rhois* Coq.

RIBES (currant, gooseberry)

Arrested buds (gooseberry)..................... *Rhopalomyia grossulariæ* Felt.
Gall undescribed, on *R. menziesii* .... *Phytophaga californica* Felt.
Red, prematurely ripe fruit.................. (?) *Dasyneura grossulariæ* Fitch.
Irregular, dark brown blister gall, diameter, 3 mm.; on *R. longifolum*.
Cecidomyia sp.

RIVINA (rouge-plant)

Reared from bud gall................................ *Schizomyia rivinæ* Felt.

ROBINIA (common locust)

Folded young leaflets.... .... *Dasyneura pseudacaciæ* Fitch.
Rolled leaf margins............................. *Obolodiplosis orbiculata* Felt.

ROSA (rose)

Curled or folded terminal leaves.................... *Dasyneura ? rosarum* Hardy.
Rose buds.......... .... *Dasyneura rhodophaga* Coq.
Rose buds.. *Clinodiplosis rosivora* Coq.
Apical, loose bud or rosette gall, length, 2 to 2.5 cm..... *Rhabdophaga rosacea* Felt.

RUBUS (blackberry)

Reared from blossoms. .... *Dasyneura rubifloræ* Felt.
Warty, pruinose leaf gall 1 to 3 cm. long............ *Lasioptera farinosa* Beutm.
Marginal leaf roll, length, 4 to 6 cm............... *Camptoneuromyia rubifolia* Felt.
Subglobular, filamentous vein gall on *R. nigrobaccus*.. *Cecidomyia* sp. (*muscosa* Steb.)
Irregular, subcortical stem gall, length, 2 cm.......... *Lasioptera nodulosa* Beutm.

RUDBECKIA (cone flower)

Irregular, subglobular apical gall, diameter, 4 cm..... *Asphondylia conspicua* O. S.
Deformed, enlarged florets, the affected florets leafy... *Cecidomyia rudbeckiæ* Beutm.
Nodular stem gall.. *Cecidomyia* sp.
Undetected gall, possibly from the unmodified stem.... *Lasioptera rudbeckiæ* Felt.

RUMEX (dock)

Reared from deformed, reddish seeds.................. *Contarinia rumicis* Loew.
Reared from same gall............................ *Lestodiplosis rumicis* Felt.

SALIX (Willow)

Fruit Galls

Enlarged seeds, reddish brown................................ *Cecidomyia*, sp.

Leaf Galls

Fusiform pod or curled leaves, length, 10 mm........... *Dasyneura salicifolia* Felt.
Closely rolled terminal leaves....................... *Rhabdophaga plicata* Felt.
Yellowish, red spotted, flattened gall, diameter, 2 to 3 mm.
Oligotrophus salicifolius Felt.

Subconic, truncate, greenish yellow, lipped gall, diameter, 2 mm. *Hormomyia verruca* Walsh.

Apparently reared from same gall. .... *Clinorhyncha filicis* Felt.

Bud Galls

Spongy or clustered rosette gall........................ *Phytophaga walshii* Felt.

Small, rosette gall, length, 2 cm...................... *Rhabdophaga racemi* Felt.

Oval, small, rosette gall resembling a small *R. brassicoides* gall. *Rhabdophaga normaniana* Felt.

Large, loose, rosette gall, length, 1 to 2 cm........... *Rhabdophaga rhodoides* Walsh.

Large, open, rosette or cabbage gall, diameter, 1 to 2 cm. *Rhabdophaga brassicoides* Walsh.

Reared from above gall.............................. *Dasyneura orbitalis* Walsh.

Reared from above gall...................... *Lestodiplosis septemmaculata* Walsh.

Reared from above gall.............................. *Rhopalomyia frater* Ckll.

Pine cone gall, length, 2 to 2.5 cm................. *Rhabdophaga strobiloides* Walsh.

Reared from above gall.......................... *Dasyneura annulipes* Walsh.

Reared from above gall.......................... *Dasyneura atricornis* Walsh.

Reared from above gall......................... *Cecidomyia atrocularis* Walsh.

Reared from above gall......................... *Dasyneura albovittata* Walsh.

Reared from above gall...................... *Lestodiplosis decemmaculata* Walsh.

Pine cone gall resembling a slender *R. strobiloides* gall. . *Rhabdophaga persimilis* Felt.

Ovate, terminal bud gall, diameter, 1 cm..... *Rhabdophaga gnaphaloides* Walsh.

Small bud gall................................. *Dasyneura californica* Felt.

Small bud gall.................................... *Rhabdophaga gemmæ* Felt.

Reared from apparently normal bud................ *Rhabdophaga latebrosa* Felt.

Small, conic, apical bud gall.......................... *Dasyneura gemmæ* Felt.

Twig Galls

Reared from willow twigs, gall undescribed.......... *Asphondylia salictaria* Felt.

Larvæ in subcortical cells, no swelling.................. *Dasyneura corticis* Felt.

Slender twigs, slightly enlarged...................... *Sackenomyia packardi* Felt.

Slender twigs, slightly enlarged...................... *Sackenomyia porteræ* Ckll.

Slender twigs, slightly enlarged..................... *Phytophaga caulicola* Felt.

Slender twigs, slightly enlarged.................... *Rhabdophaga caulicola* Felt.

Twigs probably hardly enlarged..................... *Phytophaga perocculta* Ckll.

Slender twigs, slightly enlarged.................... *Phytophaga americana* Felt.

Twigs uniformly enlarged, gall 5 to 7 cm. long.......... *Rhabdophaga podagræ* Felt.

Gall similar to above, cells in wood................ *Rhabdophaga cornuta* Walsh.

Twigs irregularly enlarged, galls 1 to 3 cm. long.......... *Rhabdophaga salicis* Schr.

Twigs irregularly enlarged, gall, 1 to 3 cm. long, buds dwarfed. *Rhabdophaga triticoides* Walsh.

Apical, fusiform, beaked gall, length, 2 cm.............. *Phytophaga rigidæ* O. S.

Reared from similar gall.......................... *Rhabdophaga sodalitatis* Felt.

Nodular gall at base of twig, length, 8 mm........... *Rhabdophaga nodulosa* Walsh.

Inconspicuous knot or twig enlargements.............. *Phytophaga latipennis* Felt.

Subglobular, lateral gall with dead area on one side, diameter, 9 mm. *Rhabdophaga globosa* Felt.

Irregular, ovoid or subglobular galls, diameter, 1 to 2 cm. *Rhabdophaga batatas* Walsh.

Same gall as above............................. *Rhabdophaga ramuscula* Felt.

Same gall dried.................................... *Asynapta saliciperda* Felt.

Subglobose galls, the surface scarred, diameter, 4 mm... *Phytophaga tumidosæ* Felt.

SAMBUCUS (elder)

Bud gall, diameter, 1.5 cm.... ....*Asphondylia sambuci* Felt.
Swollen, unopened florets........................*Youngomyia umbellicola* O. S.
Rolled leaves...................................*Arthrocnodax sambucifolia* Felt.
Irregular, subcortical gall, length, 2 to 4 cm...........*Neolasioptera sambuci* Felt.

SCIRPUS (bulrush)

Gall undescribed .... *Cecidomyia* sp.

SCROPHULARIA (figwort)

Reared from distorted flower bud................*Lestodiplosis scrophulariæ* Felt.

SECALE (rye)

Reared from heads...................................*Itonida tritici* Kirby.

SENECIO (ragweed)

Stem gall undescribed.............................*Lasioptera arizonensis* n. sp.
Flower heads...*Cecidomyia* sp.

SCUTELLARIA (skullcap)

Oval, greenish stem gall, length, 8 mm...........................*Cecidomyia* sp.

SETARIA GLAUCA (fox tail)

Reared from seeds...............................*Contarinia sorghicola* Coq.

SICCA (Otaheiti gooseberry)

Unripe fruit..*Asphondylia siccæ* Felt.

SISYMBRIUM (hedge mustard)

Irregular bud gall, diameter, 8 mm...................*Dasyneura ? sisymbrii* Schr.

SMILAX HERBACEA (carrion flower)

Blister gall, diameter, 4 mm.....................................*Cecidomyia* sp.

SMILAX ROTUNDIFOLIA (green brier)

Reared from oval, blister-like leaf spots............*Camptoneuromyia rubifolia* Felt.
Young leaves rolled longitudinally..................*Dasyneura smilacifolia* n. sp.

SMILICINA (false spikenard)

Deformed berries...............................*Asphondylia smilicinæ* Felt.
Root gall...*Dasyneura* sp.

SOLANUM CAROLINENSE (horse nettle)

Irregular, spiny stem gall, length, 3.75 to 5 cm.........*Neolasioptera solani* Felt.

SOLIDAGO (goldenrod)

Flower Galls

Greenish or reddish, subglobular, bud-like gall, diameter, 2 mm.; on *S. canadensis*. *Rhopalomyia racemicola* O. S.
Green, densely pubescent, cylindric gall, length, 6 mm.; on *S. canadensis*. *Rhopalomyia anthophila* O. S.
Reared from undescribed flower gall ....*Rhopalomyia cruziana* Felt.

Reared from apparently unaffected florets...........*Asphondylia monacha* O. S.
Gall undescribed, apparently unaffected florets.........*Asphondylia johnsoni* Felt.

Bud Galls

Apical bud galls.

Loose, convolute mass of developing leaves, diameter, 6.5 mm. *Asteromyia convoluta* Felt.

Loose apical pod of narrow, adherent leaves on *S. canadensis*. *Dasyneura folliculi* Felt.

Gall composed of two or more leaves with edges adherent, length, 2.5 to 5 cm.; on *S. graminifolia*....................*Dasyneura flavicornis* Felt.

Gall closely adherent, pyriform, apical, length, 1 mm. *Camptoneuromyia flavescens* Felt.

Probably a loose, apical bud gall on *S. graminifolia*. *Dasyneura carbonaria* Felt.

Subglobose, white or brownish apical galls on stems or subterranean root stocks, diameter, 2.5 cm.; on *S. juncea*.......*Rhopalomyia hirtipes* O. S.

Apical, cylindric, bud gall on subterranean root stock, length, 6 mm.; diameter, 2.5 mm.................................*Rhopalomyia bulbula* Felt.

Apical rosette galls.

On *Solidago canadensis*.

Deformed head about 11 cm. in diameter, 3 cm. high; composed of numerous smaller heads............................*Rhopalomyia carolina* Felt.

Gall globular, head 4 to 5 cm. in diameter......*Rhopalomyia solidaginis* Loew.

Large, rosette gall similar to the above........*Rhopalomyia albipennis* Felt.

Reared from similar gall......................*Lestodiplosis carolinæ* Felt.

Reared from similar gall......................*Lestodiplosis solidaginis* Felt.

Large, terminal, rosette gall.................*Oligotrophus inquilinus* Felt.

On *Solidago canadensis* and *S. serotina*.

Gall large, diameter, 2.5 cm.; composed of numerous small cells. *Rhopalomyia capitata* Felt.

Reared from same gall as above...............*Rhopalomyia inquisitor* Felt.

On *Solidago graminifolia*.

Gall, green, resembling that of *Œdaspis polita*, diameter, 1 to 1.5 cm. *Asphondylia monacha* O. S.

Presumably reared from the same gall.......*Camptoneuromyia flavescens* Felt.

Gall, very similar to the above, the maker possibly inquiline. *Rhopalomyia lanceolata* Felt

On *Solidago sempervirens*.

Gall, similar to that described above.............*Asphondylia monacha* O. S.

Leaf Galls

Galls attached to one, or at most two leaves and producing a marked deformity.

On *Solidago graminifolia*.—Gall greenish, red marked, ribbed, fusiform, sessile, length, 6 mm...........................*Rhopalomyia fusiformis* Felt.

Gall, green, red marked, fusiform, stemmed, length, 13 to 14 mm. *Rhopalomyia pedicellata* Felt.

On *Solidago puberula* or *S. juncea*.—Gall greenish, irregular, oval, length, 1 cm.; composed of clusters of root leaves...........*Dasyneura radifolii* Felt.

On *Solidago rugosa*.—Gall green, red marked, fusiform, length, 1.6 mm. *Rhopalomyia clarkei* Felt.

On *Solidago canadensis* and *S. serotina*.—Oval gall between adherent leaves, diameter, 2 mm.......... ....*Asphondylia monacha* O. S.
Reared from similar gall....................*Camptoneuromyia adhesa* Felt.
Possibly reared from similar gall.............*Lasioptera argentisquamæ* Felt.
Possibly reared from similar gall.................*Trotteria solidaginis* Felt.

Blister-like galls occurring in the leaf tissues and not producing a marked deformity.
Gall oval, black, 4 to 5 mm. long; on *S. graminifolia*. .*Asteromyia carbonifera* Felt.
Grayish brown, black margined, irregular gall, diameter, 3 mm.; on *S. squarrosa*. *Asteromyia squarrosæ* Felt.
Marginal, golden gray, circular gall, diameter, 3.5 mm.; on *S. canadensis*. *Asteromyia flavoanulata* Felt.
A variable pink or rosy, circular gall, diameter, 1 cm.; on *S. rugosa*. *Asteromyia rosea* Felt.
Presumably reared from oval, blister gall on *S. canadensis*. *Asteromyia socialis* Felt.
Reared from blister gall on Solidago and also from aster, gall on latter with diameter 3 to 4 mm.....................*Asteromyia albomaculata* Felt.
Variegated, oval gall, diameter, 3 to 6 mm.; the older galls mostly black, the younger yellowish olive with a darker central nipple; on *S. rugosa*. *Asteromyia rubra* Felt.
Apparently reared from similar gall................*Lestodiplosis rugosa* Felt.
Marginal, semi-oval, yellowish gall, length, 1 cm.; on *S. canadensis*. *Asteromyia flavolunata* Felt.
Elongate, yellowish brown, blistered area, length, 3 cm.; on *S. canadensis*. *Lestodiplosis triangularis* Felt.

Stem Galls

On *Solidago graminifolia*.—Gall greenish, red marked, ribbed, fusiform, sessile, length 6 mm...............................*Rhopalomyia fusiformis* Felt.
Gall green, red marked, fusiform, stemmed, length, 13 to 14 mm. *Rhopalomyia pedicellata* Felt.
Gall green, subglobular, near tip, diameter, 1.5 cm.......*Rhopalomyia lobata* Felt.
Gall a uniform enlargement of the stem, length, 10 cm., diameter, 7 mm. *Lasioptera cylindrigallæ* Felt.
On Solidago, various species.—Irregular, subglobose or fusiform enlargement, length, 2.5 cm....................................*Lasioptera tumifica* Beutm.
Gall globose or subglobose, smooth, brownish, apical on either aërial or subterranean stems, diameter, 2 5 cm.; on *S. juncea* . . ..*Rhopalomyia hirtipes* O. S.
Solitary or clustered, ovoid, fleshy gall on root stock... *Rhopalomyia thompsoni* Felt.

Sorghum

Reared from seeds........... ....*Contarinia sorghicola* Coq.

Spiræa salicifolia (meadow sweet)

Slightly enlarged, reddened flowers......................*Itonida spiræafloræ* Felt.
Reared from unopened flowers.......................*Prodiplosis floricola* Felt.
Deformed, deep red or purplish and greenish leaf buds, length, 1 cm., diameter, 4 mm. ? *Asphondylia* sp.
Terminal, globular bud gall, diameter, 4 mm..............*Hormomyia clarkei* Felt.
Terminal brown bud gall, diameter, 3 mm..............*Itonida spiræina* n. sp.
Terminal, clustered bud gall, diameter, 3 mm.; length, 7 mm. *Parallelodiplosis clarkei* n. sp.

Terminal bud gall, the leaflets fringed, diameter, 3 to 4 mm.........*Cecidomyia* sp.
Terminal "cabbage" or "lettuce" bud gall...........*Contarinia spirœina* n. sp.
Thickened, greenish midrib fold, length, 1 to 1.5 cm......*Rhabdophaga salicifolia* Felt.
Apparently reared from same gall...............*Lestodiplosis spirœafolia* Felt.
Marginal leaf rolls, length, 3 mm...................*Parallelodiplosis spirœ* Felt.
Yellowish brown, spotted, blister galls, diameter, 3 mm...*Lasioptera spiraeafolia* Felt.

TAXODIUM (bald cypress)

A conical, globular or elongate deformation of the leaf........*Itonida taxodii* n. sp.
Fusiform twig gall, length, 1.25 cm...................*Thecodiplosis ananassi* Riley.

TECOMA (trumpet creeper)

Reared from curled leaves...............................*Itonida tecomiœ* Felt.

THALICTRUM (meadow rue)

Enlarged seed pods, length, 8 mm.....................*Asphondylia thalictri* n. sp.
From same gall, probably zoophagous...........................*Trotteria* sp.

TILIA (basswood)

Irregular swelling on twig and petiole...............*Cecidomyia citrina* O. S.
Subglobular, brownish leaf galls, diameter, 3 mm.....*Cecidomyia verrucicola* O. S.
Apparently reared from above gall...................*Porricondyla dilatata* Felt.
Irregular, distorted galls at base of leaf or along midvein, subglobular.
Colpodia pectinata Felt.

TRIDENS FLAVUS (tall red top)

Reared from seeds.................................*Contarinia sorghicola* Coq.

TRIFOLIUM (clover)

Folded leaflets variably discolored with reddish and yellowish; on *T. repens*.
Dasyneura trifolii Loew.
Yellowish larvæ in flower heads; on *T. pratense*.......*Dasyneura leguminicola* Lintn.

TRIPSACUM (sesame grass)

Larvæ between leaf blades...........................*Lasioptera tripsaci* Felt.

TRITICUM (wheat)

Reared from wheat heads.................................*Itonida tritici* Kirby.
Associated with the above...........................*Cecidomyia inimica* Fitch.
Associated with the above..........................*Lestodiplosis graminis* Fitch.
Under the leaf sheath..............................*Phytophaga destructor* Say.
Probably the same.................................*Cecidomyia culmicola* Morr.

ULMUS (elm)

Decaying bark...*Oligarces ulmi* n. sp.
Aborted buds...*Dasyneura ulmea* Felt.
Adherent, immature, terminal leaves or leaf buds........*Phytophaga ulmi* Beutm.

UNKNOWN PLANTS

Irregular, subglobular bud gall, diameter, 6 mm.........*Asphondylia florida* Felt.
Reared from bud gall..............................*Asphondylia baroni* Felt.

Irregular, subglobular to elongate, fusiform stem gall, length, 0.7 to 1.5 cm. *Lasioptera palustris* Felt.
Undescribed stem gall.......................... *Lasioptera spinulæ* Felt.
Undescribed stem gall.............................. *Neolasioptera hirsuta* Felt.

URTICA (nettle)

Urn-shaped, subsessile, pale green midrib or vein gall, diameter, 3 mm. *Cecidomyia urnicola* O. S.
Hoary, pubescent, yellowish white gall on under surface of leaf, diameter, 2 mm. *Cecidomyia* sp.

VACCINIUM (cranberry)

Apical bud gall on blueberry........................ *Dasyneura cyanococci* Felt.
Oval, valved, midrib gall, length, 3 mm. *Dasyneura gaylussacii* (*vaccinii* O. S. not Smith).
Leaf fold or bud gall on cranberry.................. *Dasyneura vaccinii* Smith.

VEGETABLE MATTER (dead or decaying)

Reared probably from decaying vegetable matter........ *Prionellus dilatata* Felt.
Reared from manure.............................. *Cordylomyia coprophila* Felt.
Reared from decaying, fungous infected stump........ *Lasiopteryx flavotibialis* Felt.

VERBENA (vervain)

Reared from marginal leaf rolls.................. *Cecidomyia verbenæ* Beutm.
Reared from rolled leaves......................... *Lestodiplosis verbenifolia* Felt.
Irregular, oval stem gall, length, 3 to 5 mm..................... *Cecidomyia* sp.

VERNONIA (ironweed)

Deformed florets or oval, petiole or midrib gall, length, 6 mm. *Lasioptera vernoniæ* Beutm.
Blossoms.................................. *Youngomyia vernoniæ* n. sp.
Probably bud gall.............................. *Asphondylia vernoniæ* Felt.

VIBURNUM (arrow-wood)

Globose bud gall, length, 4 mm..................... *Schizomyia viburni* Felt.
Minute, blister gall on under side of leaf, diameter, 2 mm. *Cystiphora viburnifolia* n. sp.
Purplish swellings on lateral veins, length, 5 mm...... *Sackenomyia viburnifolia* Felt.
Irregular, subcortical gall, length, 2 to 6 cm.; on *V. dentatum* *Neolasioptera viburnicola* Beutm.
Marginal leaf roll, length, 10 mm.; on *V. cassinoides*.............. *Cecidomyia* sp.
Circular, blister gall, diameter, 1.5 to 2 mm.; on *V. cassinoides*....... *Cecidomyia* sp.
Pustulate, blister-gall with pinkish aureola, diameter, 3 mm.; on *V. acerifolium*. *Cecidomyia* sp.
Oval, greenish, blister galls, diameter, 2 mm., larvæ deep red; on *V. dentatum*. *Cecidomyia* sp.

VIOLA (violet)

Deformed fruit, irregular, "plum-like," length, 1 cm.... *Dasyneura semenivora* Beutm.
Rolled, discolored leaves............................ *Phytophaga violicola* Coq.

VITIS (grape).

Enlarged blossom buds.............................Contarinia *johnsoni* Sling.
Clustered, fusiform, woolly, pubescent bud galls, each 1 to 1.5 cm. long.
Schizomyia coryloides Walsh & Riley.
Hard, nut-like, polythalamous bud gall, diameter, 1.5 cm.
Schizomyia pomum Walsh & Riley.
Possibly reared from same gall.....................*Rhabdophaga hirticornis* Felt.
Oval, petiole or tendril gall, length, 2.5 cm...........*Schizomyia petiolicola* Felt.
Reared from similar gall.......................*Neolasioptera vitinea* Felt.
Reared from similar gall.......................*Asteromyia petiolicola* Felt.
Reared from similar gall...............................*Lasioptera riparia* Felt.
Irregular, tumid, greenish or reddish leaf or tendril gall, diameter, 0.5 to 1.5 cm.
Lasioptera vitis O. S.
Reared from similar gall...............................*Dasyneura vitis* Felt.
Reared from similar gall...............................*Rhizomyia vitis* Felt.
Reared from similar gall...............................*Brachyneura vitis* Felt.
Reared from similar gall...........................*Janetiella brevicauda* Felt.
Elongate, conical, reddish or greenish gall, length, 6 to 9 mm..*Cecidomyia viticola* O. S.
Reared from Phylloxera gall........................*Lestodiplosis grassator* Fyles.

YUCCA (Spanish bayonet)

Reared from pods...................................*Dasyneura yuccæ* Felt.
Reared from stem, probably inquiline..................*Lestodiplosis yuccæ* Felt.

ZIZIA (Golden Alexanders)

Fusiform stem gall, length, 3 cm...........................*Lasioptera ziziæ* Felt

ZOOPHAGOUS

Reared from Eriophyes gall on ash..................*Endaphis americana* Felt.
Reared from bee hive infested with mites............*Arthrocnodax apiphila* Felt.
Reared from *Aphis gossypii*.........................*Aphidoletes marina* Felt.
Reared from the above.............................*Aphidoletes cucumeris* Lintn.
Reared from tulip leaves presumably infested by aphids....*Aphidoletes borealis* Felt.
Reared from *Siphonophora liriodendri*...............*Aphidoletes meridionalis* Felt.
Reared probably from aphids on Tanicetum............*Aphidoletes basilis* Felt.
Reared from Phylloxera galls.......................*Lestodiplosis grassator* Fyles.
Reared from *Hemichionaspis minor*..................*Lestodiplosis peruviana* Felt.
Reared from *Aspidiotus uvæ*..........................*Dentifibula cocci* Felt.
Reared from *Saissetia nigra*..........................*Diadiplosis cocci* Felt.
Reared from Lecanium on beech leaves...........*Coccidomyia pennsylvanica* Felt.
Reared from Orthezia and Dactylopius ....*Cecidomyia coccidarum* Ckll.
Lobodiplosis coccidarum Felt.
Mycodiplosis coccidivora n. sp.
Dicrodiplosis coccidarum n. sp.
Reared from Tetranychus on lemon................*Mycodiplosis acarivora* Felt.
Reared from Eriophyes on cotton..................*Arthrocnodax abdominalis* Felt.
Cecid larvæ preying on eggs of *Cicada septendecim*................. *Cecidomyia* sp.

NEW SPECIES OF GALL MIDGES

By E. P. Felt, *Albany, N. Y.*

The following descriptions of Itonidæ relate to species recently reared or to reared forms recently determined as new.

Joanissia pennsylvanica n. sp. *Male.*—Length 1 mm. Antennæ presumably dark brown; fourteen segments, the fifth with a smooth stem about one-fourth longer than the oval subglobose enlargement; terminal segment produced, narrowly oval and with a stout apical process about 1-3 the length of the basal enlargement. Palpi; the first segment subglobose, the second narrowly oval, with a length twice its diameter, the third nearly as long, the fourth narrowly fusiform. Body colors presumably dark brown or fuscous as in other species. Wings hyaline, rather broad, the tip of subcosta apparently obsolete though it reaches about to the basal half of the wing, the third vein united to subcosta just before the point where it disappears by a long, oblique crossvein and joins the margin just beyond the apex, the fifth vein disappearing distally. Metatarsus of the posterior legs about two and one-half times the length of the second segment; claws strongly curved almost at right angles, slender, the pulvilli shorter than the claws. Genitalia apparently of the normal type as in *J. photophila* Felt.

Female.—Length 1.25 mm. Antennæ with eleven segments, the fifth with a stem about as long as the narrowly ovate basal enlargement. Ovipositor short, triarticulate, the terminal lobe narrowly oval and thickly clothed apically with long, stout setae.

Reared from peony roots collected by B. H. Farr of Reading, Pa., and submitted for study by Prof. H. A. Surface. Type C a1928.

KRONOMYIA n. g.

The remarkable form described below is evidently allied to Brachyneura, Rond., though readily separated therefrom by the four long veins, the fifth and sixth being simple, and the totally different antennal structure. The antennæ in the female of this species have but twelve segments, the apical evidently composed of two closely fused reduced segments, the other flagellate ones with a short stem and a short, stout basal enlargement ornamented with a basal whorl of long, stout setæ and a thick band of short, curved setae. The The biarticulate palpi with the greatly produced, capitate terminal segment and the peculiar ovipositor, all serve to differentiate this species from allied genera. Type *K. populi* n. sp.

Kronomyia populi n. sp. *Female.*—Length 1.75 mm. Antennæ extending to the second abdominal segment, thickly haired, fuscous; twelve segments, the first broadly obconic, the second very short, almost disk-shaped, the third and fourth free, the fifth with a stem about one-fourth the subcylindric basal enlargement, which latter has a length one-half greater than its diameter, a sparse subbasal whorl

of very long, stout setæ and a thick subapical band of shorter, strongly curved setæ; terminal segment produced, with a length over four times its diameter and tapering nearly uniformly to a subacute apex. Palpi; first segment narrowly oval, with a length about one-half greater than its diameter, the second segment with a length three times the first, the basal half slender, the distal portion greatly enlarged and sparsely setose. Mesonotum dark brown. Scutellum sooty white basally, fuscous apically, post-scutellum sooty white. Abdomen with the sclerites fuscous yellowish the incisures and pleuræ whitish. Ovipositor fuscous, the terminal lobes yellowish. Wings fuscous, thickly clothed with narrow scales; costa black, thickly scaled, subcosta uniting therewith at the basal third, the third vein well beyond the apex, the simple fifth at the distal third, the sixth near the basal half, the two latter rudimentary. Halterese whitish basally, fuscous apically; tibiæ and tarsi a somewhat variable fuscous. Claws stout, strongly curved, unidentate, the pulvilli about one-third the length of the claws. Ovipositor strongly curved ventrally and anteriorly, the convex rounded surface chitinized, its surface and the dorsal and ventral plates of the preceding segment with numerous chitinous, finely denticulate, transverse ridges; terminal lobes extending posteriorly, slender, with a length about four times the diameter, narrowly rounded apically and sparsely setose.

Reared from punky poplar wood collected at Nassau, N. Y.Type C. a 2152.

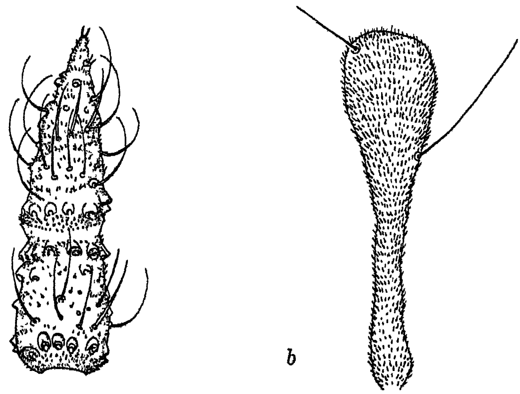

Fig. 11. *Kronomyia populi*, female: *a*, terminal antennal segment; *b*, distal palpus segment (Original)

Oligarces ulmi n. sp. *Male.*—Length 0.8 mm. Antennæ short, very sparsely haired, whitish transparent; eleven segments, the fifth subcylindric, with a length about one-fourth greater than its diameter; terminal segment slightly produced, sometimes nearly fused with the preceding, and with a length nearly one half greater than its diameter, and broadly rounded apically. Mesonotum light brown. Scutellum yellowish transparent, postscutellum slightly fuscous. Abdomen yellowish orange, reddish basally, the genitalia a light fuscous. Halteres whitish transparent. Legs yellowish transparent; claws long, moderately stout, nearly straight, the pulvilli rudimentary. Genitalia; basal clasp segment moderately long, stout, obliquely truncate; terminal clasp segment long, stout, swollen near the middle, broadly rounded apically and thickly setose; dorsal plate short, broadly and roundly emarginate, the lobes broadly rounded and sparsely setose; ventral plate long,

broadly and roundly emarginate, the lobes short, broadly rounded and sparsely setose. Style long, tapering, narrowly rounded apically. Occasionally a pale yellowish male may be observed.

Reared in large numbers from decaying elm bark collected at Nassau, N. Y., March 11, 1911. Type C. a2136.

Winnertzia pectinata n. sp. *Male.*—Length, 1.75 mm. Antennæ fuscous yellowish; fourteen segments, the fifth with a stem three-fourths the length of the subcylindric basal enlargement, which latter has a length one half greater than its diameter; terminal segment with a length about twice its diameter, narrowly rounded apically. Palpi yellowish transparent, first segment with a length fully two and one half times its diameter, the second with a length thrice its diameter, the third a little longer than the second, the fourth fully one-half longer than the third. Face fuscous yellowish. Mesonotum dull fuscous brown. Scutellum and postscutellum brownish black. Abdomen fuscous yellowish, the small, irregularly ovoid dorsal sclerites slightly fuscous; terminal segments and gentalia fuscous. Wings hyaline, costa dark brown. Halteres yellowish transparent. Coxae and femora mostly yellowish transparent; tibiæ light fuscous yellowish; tarsi mostly fuscous yellowish, the fifth segment of the midtarsi yellowish; claws stout, strongly curved, unidentate, the pulvilli short. Genitalia; basal clasp segment moderately long, stout; terminal clasp segment long, swollen at the distal fourth and apically with a strongly pectinate chitinous spur; dorsal plate moderately long, broad, broadly and slightly emarginate, the lobes broadly rounded; ventral plate long, deeply and triangularly emarginate, the lobes broad, truncate and sparsely haired.

Reared from partly decayed chestnut bark collected at Nassau, N. Y., April 26, 1911. Allied to *W. calciequina* Felt. Type C. a2109.

Rhizomyia hirta n. sp. *Female.*—Length 1 mm. Antennæ rather thickly haired; twelve segments, the fifth with a stem one-fourth the length of the cylindric basal enlargement, which latter has a length two and one half times its diameter; terminal segment with a length six times its diameter. Palpi; first segment short, stout, the second subrectangular, with a length four times its diameter, the fourth a little longer, slender. Mesonotum fuscous yellowish. Scutellum, postscutellum and abdomen reddish yellow, the basal segment fuscous. Wings hyaline, costa dark brown, subcosta uniting therewith at the basal fourth. Halteres yellowish, fuscous subapically. Coxæ and femora basally yellowish; femora distally and tibiæ fuscous yellowish, the tarsi darker; claws long, slender, strongly curved, the pulvilli shorter than the claws. Ovipositor short, terminal lobes broadly ovate and sparsely setose.

Reared from a reddish, blister-like leaf mine on Cratægus taken at Bath, N. Y. Type C. a1756a.

Dasyneura communis n. sp. *Male.*—Length 1.3 mm. Antennæ dark brown; sixteen segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length one-half greater than its diameter; terminal segment produced, tapering to a narrowly rounded apex with a length five times its diameter. Palpi; first segment short, incrassate, the second narrowly oval, the third one-half longer, slender, the fourth one-fourth longer and more slender. Mesonotum shining dark brown. Scutellum and postscutellum dark brown. Abdomen

dark brown, the segments margined posteriorly with yellowish setæ; membrane and pluræ yellowish orange; venter orange yellowish; genitalia fuscous yellowish. Wings hyaline, costa dark brown. Halteres yellowish orange. Coxæ fuscous yellowish; femora and tibiæ mostly cinereous, slightly fuscous apically; tarsi mostly dark brown; claws long, slender, strongly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, truncate; terminal clasp segment rather long, stout; dorsal plate broad, deeply and triangularly emarginate, the lobes narrowly rounded and sparsely clothed with long setæ apically; ventral plate long, deeply and broadly emarginate, the lobes tapering to a narrowly rounded, sparsely setose apex. Harpes broad, stout, irregular apically; style short, stout.

Female.—Length 1.5 mm. Antennæ fuscous yellowish; sixteen subsessile segments, the fifth with a length three-fourths greater than its diameter; terminal segment produced, narrowly rounded apically. Palpi; first segment short, stout, irregular, second subquadrate, with a length three times its width, the third one-half longer, slender, the fourth one half longer than the third. Mesonotum shining dark brown, the submedian lines thickly haired. Scutellum dark reddish brown, postscutellum dark orange. Abdomen dark brown, the segments sparsely setose posteriorly; membrane, pluræ and venter dark reddish; ovipositor pale orange. Wings hyaline, costa dark brown. Halteres yellowish basally, reddish orange apically. Coxae fuscous orange; femora and tibiæ yellowish straw; tarsi slightly darker, especially the distal segments. Ovipositor as long as the abdomen, the terminal lobes narrow oval sub-acute apically.

Reared from jar containing maple leaves bearing reddish tinted pouch, vein galls ¼ inch long. Type C. a1133.

Dasyneura gibsoni n. sp. *Male.*—Length 1.5 mm. Antennæ dark brown; fifteen segments, the fifth with a stem one fourth longer than the cylindrical basal enlargement, which latter has a length one fourth greater than its diameter; terminal segment reduced, narrowly oval. Palpi; first segment short, subquadrate, the second with a length nearly three times its width, narrowly rounded, the third one half longer than the second, slender, the fourth nearly as long as the third, somewhat dilated. Mesonotum dark brown. Scutellum reddish brown, postscutellum yellowish brown. Abdomen dark brown. Genitalia fuscous. Wings hyaline, costa dark brown, the third vein nearly straight. Halteres yellowish transparent. Coxæ and femora mostly fuscous yellowish, the tibiæ and tarsi dark brown. Claws slender, strongly curved, unidentate, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment rather long, stout; terminal clasp segment stout, tapering; dorsal plate deeply and triangularly incised, the lobes narrowly rounded; ventral plate triangularly emarginate, the lobes stout, tapering. Harpes long, tapering, tuberculate. Style short, narrowly rounded.

Female.—Length 1.75 mm. Antennæ fuscous yellowish; fifteen subsessile segments, the fifth with a length one half greater than its diameter; terminal segment somewhat reduced, and partly fused with the preceding. Scutellum and postscutellum fuscous yellowish. Abdomen dark brown. The fuscous yellowish ovipositor, about as long as the body, terminal lobes rather broad, with a length about twice the diameter, narrowly rounded apically. Halteres, coxæ and base of femora pale yellowish, the distal portion of femora, tibiæ and tarsi fuscous yellowish. Other characters nearly as in the male.

Reared from flower heads of Canada thistle, *Cirsium arvense* collected by Arthur Gibson in the vicinity of Ottawa, Canada. Allied to *D. salicifolia* Felt. Type C. a2221.

Dasyneura pergandei n. sp. *Male.*—Length 1.5 mm. Antennæ dark brown or black; seventeen segments, the fifth having a stem as long as the cylindrical basal enlargement, which latter has a length one half greater than its diameter; terminal segment reduced, narrowly oval, with a length twice its diameter. Palpi; first segment subrectangular, with a length fully twice its diameter, the second a little longer, stouter, the third one fourth longer and more slender, the fourth a little longer than the third. Mesonotum dark brown, the submedian lines fuscous yellowish. Scutellum and postscutellum fuscous yellowish. Abdomen dark red. Wings hyaline, costa yellowish, the slightly curved third vein uniting therewith at the distal ninth. Halteres reddish orange. Legs reddish yellow; claws stout, strongly curved, the pulvilli as long as the claws. Genitalia obscured in the preparation.

Female.—Length 1.5 mm. Antennæ fuscous yellowish; eighteen segments, the fifth cylindric, with a length twice its diameter; terminal segment with a length twice its diameter and tapering to a subacute apex. Palpi nearly as in the opposite sex. Ovipositor when extended probably as long as the body, the terminal lobes with a length three times the diameter, tapering distally and sparsely setose.

Reared by Theodore Pergande in 1878 from swollen fruit of wild cherry collected by Prof. C. V. Riley at Glenn Ayrie, Col.

Dasyneura smilacifolia n. sp. *Male.*—Length 0.75 mm. Antennæ dark brown, with fifteen to seventeen segments, the fifth with a stem about three fourths the length of the basal enlargement, which latter has a length two and one fourth times its diameter. The terminal segment may be greatly prolonged, slender and evidently composed of two closely fused, or reduced and sessile. Palpi; first segment irregularly subquadrate, the second with a length about two and one-half times the diameter, rounded at each extremity, the third a little longer, more slender, the fourth one half longer than the third. Mesonotum reddish brown. Scutellum, postscutellum and abdomen mostly fuscous yellowish, the latter sparsely haired. Genitalia light fuscous. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Coxæ and femora a pale straw, the tibiæ fuscous yellowish, the tarsi a light fuscous, the distal tarsal segments darker; claws slender, strongly curved, unidentate; pulvilli a little shorter than the claws. Genitalia; basal clasp segment rather long, moderately stout; terminal clasp segment stout, slightly curved; dorsal plate deeply and triangularly incised, the lobes narrowly rounded and sparsely setose; ventral plate rather short, broad, broadly rounded. Harpes long, tapering, slightly subtruncate and irregularly tuberculate apically.

Female.—Length 0.9 mm. Antennæ dark brown; sixteen subsessile segments, the fifth with a length about twice its diameter; terminal segment reduced, subglobose. Mesonotum reddish brown. Scutellum, postscutellum and abdomen fuscous yellowish, the latter sparsely haired and in some specimens reddish orange. Ovipositor fuscous yellowish and nearly as long as the abdomen when extended; terminal lobes slender, with a length nearly four times the width, sparsely and minutely setose apically. Other characters practically as in the male.

Reared the latter part of August from rolled leaves of Smilax, (green brier) collected by Miss Cora H. Clarke at Magnolia, Mass. Allied to *D. clematidis* Felt. Type C. a2214.

Cystiphora viburnifolia n. sp. *Female.*—Length 1 mm. Antennæ pale orange; fourteen subsessile segments, the fifth with a length one fourth greater than its diameter; terminal segment reduced, narrowly oval. Palpi; first segment with

a length twice its diameter, the second and third subequal. Mesonotum brownish orange. Scutellum and postscutellum pale orange. Abdomen pale yellowish. The ovipositor short, the basal fleshy portion light orange, the distal part cultriform, sparsely setose apically. Wings rather narrow, costa pale straw. Halteres whitish transparent. Coxæ and femora mostly pale yellowish; tibiæ fuscous yellowish, the tarsi mostly dark brown; claws long, slender, evenly curved, unidentate, the pulvilli as long as the claws.

Reared from an inconspicuous elevation on the under side of the leaf of hobble bush, Viburnum, taken by Miss Cora H. Clarke at Magnolia, Mass. Superficially it resembles *Sackenomyia viburnifolia* Felt. Type C. a1897.

Asteromyia nigrina n. sp. *Female.*—Length 1.2 mm. Antennæ dark brown, the distal segments yellowish; seventeen segments, the fifth having a length about equal to its diameter; the terminal segment with a length over twice its diameter. Palpi; first segment short, irregular, the second narrowly oval, with a length about twice its diameter, the third a little longer and more slender. Mesonotum dark brown, scutellum dark reddish brown, with a few whitish scales or setæ apically; postscutellum dark brown. Abdomen a nearly uniform dark brown, almost black. Wings hyaline, costa dark brown, the third vein uniting therewith at the basal half. Halteres fuscous yellowish. Coxæ dark brown; femora, tibiæ and tarsi dark brown, the first and second segments narrowly annulate basally with whitish. Ovipositor about half the length of the abdomen; terminal lobes very broadly and irregularly oval, thickly setose.

Reared from a jar containing inconspicuous blister galls on the leaves of witch hazel, *Hamamelis virginica* collected by Miss Cora H. Clarke at Magnolia, Mass. Type C. a1780b.

Asteromyia reducta n. sp. *Male.*—Length 1.5 mm. Antennæ blackish; twelve segments, the fifth with a length about equal to its diameter; terminal segments produced, with a length two and one half times its diameter, narrowly rounded apically. Palpi uniarticulate. Mesonotum dark reddish brown. Scutellum reddish brown; postscutellum a little darker. Abdomen dark brown, the distal segments reddish; genitalia fuscous. Wings hyaline, costa dark brown, the third vein uniting with the margin at the basal half. Halteres fuscous basally, whitish apically. Legs fuscous yellowish, the distal tarsal segments lighter; claws long, moderately slender, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment moderately stout, truncate; terminal clasp segment short, swollen basally; dorsal plate deeply and triangularly divided, the lobes broadly rounded, sparsely setose; ventral plate broad, broadly rounded, sparsely setose. Halteres irregularly triangular; style short, stout, broadly rounded.

Female.—Length 1.5 mm. Antennæ with thirteen or fourteen segments, the fifth with a length about equal to its diameter; terminal segment with a length about twice its diameter, broadly rounded apically. Color characters nearly as in the opposite sex, except that the distal segments of the abdomen seem to be a more nearly uniform reddish brown. Ovipositor when extended, about half the length of the abdomen, the terminal lobes narrowly oval, with a length twice the width and thickly setose.

Reared from an irregularly oval, blackish blister gall with a diameter of 4 mm. on *Aster undulatus* collected at Magnolia, Mass., by Miss Cora H. Clarke. Type C. a2056.

Lasioptera allioniæ n. sp. *Female.*—Length 1.25 mm. Antennæ short, fuscous; sixteen segments, the fifth with a length three fourths its diameter. Palpi; the first segment short, incrassate, the second quadrate, with a length about twice its diameter, the third probably as long as the second, the fourth slender and presumably one-half longer than the third. Mesonotum dark brown, broadly margined laterally and anteriorly with short, silvery scales. Scutellum fuscous, sparsely clothed with silvery scales, postscutellum fuscous. Abdomen a nearly uniform purplish black, the first to the sixth segments with submedian, triangular, whitish spots posteriorly; venter suffused with white scales. Wings hyaline, costa dark brown, the discal spot just before the basal half, the third vein uniting with costa near the basal third. Halteres snow white. Coxæ dark brown; femora and tibiæ yellowish basally, dark brown apically; tarsi dark brown, probably banded; ovipositor yellowish, about as long as the abdomen, the lobes narrowly oval, setose.

Male.—Length 1.75 mm. Antennæ dark brown; sixteen segments, the fifth with a length about one fourth greater than its diameter, the terminal segment broadly rounded apically, with a length three fourths its diameter. Mesonotum dark brown, almost black, the submedian lines sparsely haired. Scutellum and postscutellum dark brown. Abdomen apparently nearly uniformly clothed with dark brown scales; genitalia fuscous. Wings hyaline, costa dark brown, the third vein uniting therewith near the basal half. Coxæ, femora and tibiæ fuscous yellowish, the tarsi darker; claws long, pulvilli shorter than the claws. Genitalia; basal clasp segment long, truncate; terminal clasp segment short, swollen basally; dorsal plate deeply and triangularly incised, the lobes tapering, narrowly rounded; ventral plate rather long, broadly rounded. Harpes stout, tapering; style narrowly rounded apically.

Reared from an irregular, fusiform, stem gall on Oxybaphus (Allionia) taken by Prof. E. Bethel at Boulder, Col. Type C. a2026.

Lasioptera arizonensis n. sp. *Male.*—Length 1.75 mm. Antennæ dark brown; sixteen segments, the fifth with a length one-fourth greater than its diameter; terminal segment slightly produced, broadly oval. Palpi; the first segment short, stout, the second with a length about two and one half times its diameter, the third a little longer, more slender, the fourth one half longer than the third, more slender. Mesonotum dark brown, the submedian lines thickly clothed with golden yellow scales. Scutellum and postscutellum dark brown. Abdomen dark brown, the basal segment and submedian spots on segments two to five silvery white; genitalia fuscous. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin near the basal third, the third vein at the basal half. Halteres pale fuscous yellowish. Legs mostly dark brown, the apices of femora and tibiæ with the second and third tarsal segments, and the fifth and sixth tarsal segments somewhat darker; claws long, slender, strongly curved, unidentate, the pulvilli as long as the claws. Genitalia; basal clasp segment long, roundly truncate; terminal clasp segment with the basal third strongly swollen; dorsal plate short, stout, deeply and narrowly incised, the lobes broadly rounded; ventral plate long, slender, broadly rounded and sparsely setose apically. Harpes long, slender, irregularly tuberculate; style long, broadly rounded apically.

Female.—Length 2 mm. Antennæ dark brown, twenty segments; the fifth with

a length about one-fourth greater than its diameter; terminal segment produced, broadly rounded. Mesonotum shining dark brown. Scutellum reddish brown, postscutellum dark brown. Abdomen a nearly uniform dark brown, the segments narrowly margined with a few white setæ. Coxæ, femora and tibiæ a variable fuscous yellowish, slightly darker distally; tarsi nearly uniform yellowish brown. Ovipositor nearly as long as the abdomen, with conspicuous lateral basal patches of halberd-shaped scales; terminal lobe long, slender, narrowly rounded apically and with a thick dorsal group of stout, slightly recurved, chitinous spines; minor lobe short, stout.

Reared from stems of *Senecio arizonensis* taken at Oracle, Ariz., April 22, 1899. Received through U. S. Bureau of Entomology. Type C. 1062.

Neolasioptera agrostis n. sp. *Male.*—Length 1.25 mm. Antennæ light brown; probably twenty or more segments, the fifth with a length a little greater that its diameter. Palpi; the first segment irregularly subquadrate, the second narrowly oval, the third a little longer, the fourth one fourth longer and more slender than the third. Mesonotum reddish brown, sparsely clothed with short yellowish scales. Scutellum light reddish brown, postscutellum dark reddish brown. Abdomen dark brown, the dorsum of the first to the fourth abdominal segments thickly clothed with silvery white scales. Wings hyaline, costa dark brown, subcosta uniting with the anterior margin near the basal third, the third vein just beyond the basal third. Halteres whitish transparent. Legs pale yellowish; Genitalia; basal clasp segment rather long, truncate; terminal clasp segment swollen at the base, tapering; dorsal plate rather long, broad, deeply and triangularly emarginate, the lobes tapering, obliquely rounded, setose; ventral plate long, broad, tapering, narrowly rounded. Harpes long, slender, tuberculate; style long, slender, narrowly rounded.

Female.—Length 1.25 mm. Antennæ dark brown; twenty-four segments, the fifth with a length a little less than its diameter; terminal segment narrowly oval. Palpi; the first segment with a length twice its diameter, the second narrowly oval, the third one third longer than the second, the fourth a little longer. Mesonotum dark reddish brown. Scutellum yellowish apically, reddish brown basally, postscutellum dark brown. Abdomen dark brown, the basal segment thickly clothed with silvery white scales, the second to fourth segments with lunate submedian silvery spots. Tarsi dark brown; claws long, slender, unidentate, the pulvilli as long as the claws. Ovipositor nearly as long as the abdomen, the dorsum of the seventh segment with submedian irregular chitinous thickenings, terminal lobes long, stout, narrowly rounded and thickly setose. Other characters as in the male.

Reared in September from *Eragrostis minor* and loaned for study by the U. S. National Museum. Type C. 1063.

Neolasioptera squamosa n. sp. *Male.*—Length 1.25 mm. Antennæ light brown; twelve segments, the fifth with a length a little greater than its diameter, terminal segment produced, tapering to a narrowly oval apex. Palpi; the second segment narrowly oval, the third longer, stouter, the fourth with a length more than twice the third. Mesonotum reddish brown, the submedian lines very thickly clothed with divergent yellowish white scales. Scutellum and postscutellum pale yellowish. Abdomen apparently a yellowish brown, with rudimentary submedian silvery markings; genitalia pale yellowish. Wings hyaline, rather long, narrow, costa dark brown, subcosta uniting with the anterior margin near the basal third, the third vein at the

long, white discal spot on the basal half. Halteres pale yellowish. Coxæ and the femora mostly pale yellowish; tibiæ and tarsi dark brown except that the first tarsal segment and the extremities of the others, except the distal one of the fifth are rather broadly banded with yellowish white; claws long, slender, unidentate, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, roundly truncate; terminal clasp segment swollen basally, tapering, obtuse apically; dorsal plate long, broad, narrowly incised, the lobes broadly rounded; ventral plate long, slender, rounded. Harpes short, stout, tapering, obtuse; style rather short, stout, rounded.

Reared from grass (presumably a gall) taken August 11, 1891 at Cadet, Mo. and loaned for study by the U. S. National Museum. Type C. 909.

Neolasioptera trimera n. sp. *Female.*—Length 1.5 mm. Antennæ dark brown, sparsely haired, twenty-one segments, the fifth with a length about one half its diameter, the last segment broadly oval. Palpi; first segment short, stout, irregular, the second almost subglobose, broadly oval, the third nearly twice the length of the second, slender. Mesonotum dark brown, the submedian lines sparsely haired. Scutellum reddish brown, postscutellum a little darker. Abdomen a nearly uniform dark brown, the segments very sparsely margined posteriorly with a few whitish hairs. Wings hyaline, costa dark brown, the third vein uniting with costa near the basal half, discal spot large. Halteres yellowish white. Legs a nearly uniform reddish brown; claws unidentate, the pulvilli nearly as long as the claws. Ovipositor yellowish, about half the length of the body; terminal lobes narrowly oval, thickly clothed with stout setæ.

Reared from a stem gall on sunflower taken at Fort Grant, Ariz., and loaned for study by the U. S. National Museum. Type C. 907.

Rhopalomyia gnaphalodis n. sp. *Female.*—Length 2 mm. Antennæ reddish brown; seventeen or eighteen subsessile segments, the fifth with a length about two and one half times its diameter; terminal segment slightly produced or fused with the preceding. Palpi; first segment short, subglobose, the second narrowly oval. Mesonotum shining reddish brown. Scutellum reddish brown, postscutellum darker. Abdomen sparsely haired, deep reddish, the basal segment darker. Costa pale straw. Halteres yellowish. Coxæ reddish brown; femora fuscous yellowish; tibiæ reddish, darker apically; tarsi reddish brown; distal tarsal segments missing in specimen; the fuscous yellowish ovipositor stout, nearly as long as the body, the lobes narrowly oval, sparsely setose.

Reared by Prof. T. D. A. Cockerell, Boulder, Col., from a woolly, polythalamous gall, diameter 1 cm., on *Artemisia gnaphalodes.* Type C. 1382.

(To be continued.)

DUTCH INSPECTION SERVICE

The following communication was received by Dr. L. O. Howard, at whose suggestion it is published.—*Ed.*

WAGENINGEN, Sept. 6th, 1911.

DEAR SIR:

Since this summer not only my oldest chief assistant, Dr. Quanjer, but also my second chief assistant, Mr. van Poeteren, is appointed by our Government for acting as substitute chief of the phytopathological service in my absence; he can also put his signature on the certificates. It seems to me necessary to send you now the signature of him. On the accompanying cards I have brought together the signatures of both my chief assistants who have been appointed as my substitutes, and of myself, and I should feel myself very much obliged to you if you would be so kind as to send those cards to those entomologists, horticultural commissioners, inspectors, etc., in the different States who are charged with the inspection of the packages with shrubs, trees and plants which are sent from the Netherlands to the United States of America. When it is good to send you more of those cards I shall do so.

I take the liberty to invoke your help, for I do not know the names of the different gentlemen to whom they ought to be sent.

I hope that I do not intrude too much on your kindness, and beg you to accept my most respectful thanks for what you will do for me and for our phytopathological service. It shall be a great favor for me when I can help you in return in something.

With very kind regards,

Yours truly,

J. RITZEMA BOS.

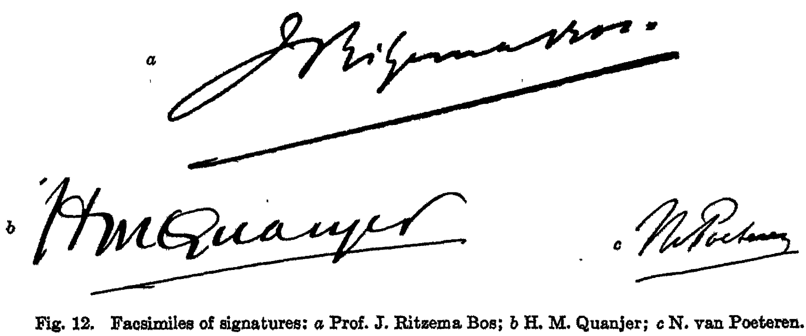

Fig. 12. Facsimiles of signatures: *a* Prof. J. Ritzema Bos; *b* H. M. Quanjer; *c* N. van Poeteren.

CORRECTION

Read lines 4 and 3 from the bottom of page 385 and after the word "preceding," as follows: "22 and 22a, *Mac. pisi,* 23, apterous female of same; 24 and 25, *Mac. ambrosiæ;* 26 and 26a, *Mac. sanborni.*" Because of too great reduction in the dimensions of Plate 16, all amplifications are three fourths as great as indicated on the plate.

C. P. GILLETTE.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

It is planned to issue the next number of the Journal December 1st instead of on the 15th as heretofore. This change was made so that the program for the annual meeting, usually published in the last number, will be in the hands of the majority of our readers at least two weeks before the time of the meeting. Furthermore, the mailing of this issue about the 15th is frequently followed by delay incident to the accompanying rush of Christmas mail. Contributors are therefore requested to forward copy to the editor by the 1st of November, though minor notices may be inserted if received by the 11th. We hope the change for this number will meet with general approval.

The recent circular (No. 27 of the U. S. Department of Agriculture) sent out over the signature of the Secretary of Agriculture is a comprehensive and moderate statement of the need for an efficient national quarantine law applying to nursery stock and plants or plant products entering into international and interstate commerce. This circular should be widely disseminated and ought to have a most beneficial influence in developing a proper attitude toward such an enactment. A law of this general character would be of inestimable value in the case of sporadic infestations such, for example, as the recently discovered presence of the gipsy moth at Lenox, Mass. The insect was in all probability brought into that locality with nursery stock, judging from the evidence available. There is no reason why similar infestations might not occur in other states and in that event it would very probably be in less progressive communities. In some instances at least, authority such as this proposed law gives would be almost necessary for the proper handling of the situation. This is a matter of vital importance to almost every tax payer in the northeastern United States at least, because unless such infestations are handled in a summary manner, it would soon mean an enormous local tax for the control of pests in unfortunate communities here and there. Experience in eastern Massachusetts has shown that such assessments may

run as high as $10,000 annually in cities with thirty to forty thousand inhabitants. This is only one instance of the marked benefits which might result from such an enactment. It would surely appear as though all fair minded citizens would recognize the necessity for such protection even though it might mean unfortunate restrictions in the case of a few. A most effective method of conserving our natural resources is to exclude or check the spread of destructive natural agents which may either cause enormous losses on account of the direct injury inflicted or necessitate heavy taxation if efficiently controlled.

Current Notes

Conducted by the Associate Editor

Mr. Alfred B. Champlain, assistant in entomology at the Connecticut Agricultural Experiment Station, resigned, October 1, to accept a new position in the Division of Economic Zoölogy at Harrisburg, Pa., where he was formerly employed. In the future Mr. Champlain will have charge of the insectary and the breeding work of the Division.

Forest Insect Station No. 5 has been established at Yreka, Calif., by the Division of Forest Insect Investigation of the Bureau of Entomology, U. S. Department of Agriculture. Mr. H. E. Burke is in charge, and is assisted by Agents A. G. Angell, J. J. Sullivan and J. B. Riggs.

Prof. E. D. Sanderson, Dean of the College of Agriculture of West Virginia University, has also been appointed Director of the Experiment Station, to succeed J. H. Stewart, who has recently resigned. The new appointment takes effect Jan. 1, 1912.

E. G. Titus received at Commencement time the degree of Doctor of Science from Harvard University, where he has been studying for the past year, and he has since been made professor of entomology at the Utah Agricultural College.

According to an announcement in Science, plans are now being made for a new entomology building at Rutgers College, New Brunswick, N. J., the same to be two stories high and to contain class rooms and museum, as well as space for Experiment Station work.

Dr. Creighton Wellman, formerly professor in the laboratory of Tropical Medicine at Oakland, California, and a student of the Coleoptera, has been appointed to a regular professorship at Tulane University, New Orleans, La.

Mr. Wesley O. Hollister, a graduate of the Connecticut Agricultural College at Storrs, has recently accepted a position with Parke, Davis & Co., Detroit, Mich. He will have charge of field tests with insecticides and preparing exhibit sets of injurious insects.

Mr. E. P. Hoff, assistant entomologist of the Utah Agricultural Experiment Station, resigned September 1st to go into commercial work, and has been succeeded by a graduate of the local college, Mr. M. A. Nelson.

Mr. W. M. Ball, a graduate of the Department of Entomology, Utah Agricultural College, has begun work on an elaborate and extensive test of arsenical poisons for the U. S. Smelting Co. of Salt Lake City.

E. W. Stafford, a graduate of the Ontario Agricultural College, has been appointed assistant in entomology at the New Jersey Agricultural Experiment Station.

H. B. Scammel has been appointed assistant entomologist at the Minnesota Agricultural Experiment Station, and has entered upon his duties.

The New Jersey State Entomologist has been authorized by the State Board of Agriculture to investigate problems relating to the foul brood diseases of bees.

Mr. James F. Zimmer, Bureau of Entomology—Deciduous Fruit Insect Investigations; Washington, D. C., goes on leave September 20th in order to take graduate work, in Entomology, at Cornell University, Ithaca, N. Y.

H. R. Niswenger and H. H. Jewett have been appointed assistant entomologists and botanists at the Kentucky Agricultural Experiment Station.

The Legislature of Ohio has appropriated $13,600 to the Agricultural Experiment Station for entomology during the biennial period of 1911 and 1912.

At the Oregon Station, A. L. Lovett has been appointed field assistant and H. E. Ewing laboratory assistant in entomology.

W. V. Tower has resigned as entomologist of the Porto Rico Experiment Station to accept a position with the Porto Rico Board of Agriculture.

A. C. Burrill has been appointed assistant in economic entomology at the University of Wisconsin.

Mailed October 16, 1911.

JOURNAL

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Vol. 4 DECEMBER, 1911 No. 6

NOTES ON THE HOST PLANTS AND PARASITES OF SOME NORTH AMERICAN BRUCHIDÆ[1]

By R. A. Cushman, *Bureau of Entomology, Washington, D. C.*

For the past four years the author has been closely connected with the work on the parasites of the cotton boll weevil. In connection with this work hundreds of lots of plant material of various kinds, infested by other weevils and bruchids have been collected and sent in to the laboratory of the investigation at Dallas, Texas. In the following pages the information collected on the latter group, as to both the host plants of the various species and their parasites, is brought together. A few other records obtained elsewhere are also included. This group of beetles, at least in breeding habits, approaching closely many of the weevils, attracts many of the parasitic enemies of that group. A number of the most important of the parasites of the boll weevil have been found to attack bruchids, and for this reason many lots of infested material were collected and placed in breeding cages and the issuing parasites recorded.

All but two of the bruchid species discussed here breed in the pods of leguminous plants. Plants of this sort are especially abundant and varied in the southern and western portions of Texas, forming a considerable part of a very characteristic flora. In this section of the state most of the leguminous plants are "chapparals" (shrubs or small trees), and occur over wide areas. Their pods furnish the breeding places of many species of this and other groups of insects. In several instances the same lot of pods was found to be infested by two species of *Bruchus*. In the more humid portions of the state and in the neighboring states to the north and east, the "chapparals"

[1] Published by permission of Dr. L. O. Howard, Chief of the Bureau of Entomology.

are largely replaced by a number of smaller legumes, which also support quite a series of bruchid species. In addition to these two classes of legumes, there are a number of trees, as the locusts and redbud, which also have their typical bruchid enemies.

The particular interest of the men employed in the work was with the parasites, and observations on the hosts were necessarily limited. But as opportunity offered observations were made and recorded.

At least eight of the species of parasites reared from bruchids are known to attack the boll weevil. Of these *Cerambycobius cyaniceps* Ashm. is, on account of its wide geographical and host range, by far the most important. It has been definitely reared from at least seven species of bruchids ranging from New Mexico to the District of Columbia, and from many other hosts in stems, fruits and buds, as well as from the boll weevil throughout the range of that species in the United States. Of the latter host it is everywhere an important enemy, becoming in some regions, notably southern Arkansas and northern Louisiana, the dominant parasite. The bruchids have undoubtedly been among the principal sources from which the boll weevil has drawn its quota of this parasite. In fact, the nature of the bruchid fauna, or rather, of the bruchid flora of the region mentioned might well account largely for the dominance of this parasite as an enemy of the boll weevil. As has already been stated, the leguminous flora of southern Texas is largely small trees or shrubs, or in other words, perennials. Their fruit is to a considerable extent indehiscent, and affords constant opportunity for the breeding of bruchids. Thus we find that a number of bruchids breed almost constantly in the pods of such plants as the huisache (*Vachellia farnesiana*) and mesquite (*Prosopis glandulosa*). This furnishes the normal bruchid parasites with an abundance of preferred hosts, and such species as *C. cyaniceps* do not become so noticeable as parasites of the boll weevil. On the other hand, the leguminous flora of the Arkansas-Louisiana region is largely annual and the fruit dehiscent. This prevents the development of more than two generations of bruchids in a year, one maturing in the late summer and the other hibernating in pods prevented from opening by the presence of the immature bruchids. This leaves nearly the whole summer in which the parasites must either not breed or must seek other hosts. The boll weevil, being the most abundant suitable host, draws to itself many of these parasites, especially those, such as *C. cyaniceps*, which are least particular as to the nature of their host. An exactly similar case exists in eastern Louisiana, where another chalcid, *Catolaccus hunteri* Cwfd., is the dominant parasite of the boll weevil. This parasite is the species most abundantly bred from the dehiscent pods of *Acuan illinoensis*, an annual legume,

attacked by *B. compressicornis* Schaef. This plant is one of the most abundant weeds along ditchbanks, headlands, and other waste lands throughout the region.

In regions where the parasites have constant access to their natural hosts, they only occasionally leave these to attack another insect. However, if, through some catastrophe, they are deprived of their normal hosts, they search for and oviposit in other suitable hosts. An instance of this catastrophic transfer of parasites from their normal host to another was furnished in the summer of 1907 at Victoria, Texas. During that season the huisache trees over a large area produced almost no pods, the normal breeding place of *Bruchus sallœi* Shp., due to the activities of a small weevil (*Tychius* sp.), which breeds in the flowers. A remarkable increase in the percentage of parasitism of the boll weevil was traced to this occurrence by the breeding from infested cotton squares of large numbers of *Cerambycobius cushmani* Cwfd., normally parasitic on *B. sallœi*.

Of the other parasites known to attack both the boll weevil and bruchids, the species of *Eurytoma* have not been determined; *Lariophagus texanus* Cwfd., though attacking certain of the bruchids abundantly, has but seldom been recorded from the boll weevil; *Bracon mellitor* Ashm., *Microdontomerus anthonomi* Cwfd., and *Habrocytus piercei* Cwfd., all normally weevil parasites, have been only occasionally reared from bruchids.

Certain of the parasites seem to be confined to the bruchids as hosts. In this class are *Urosigalphus bruchi* Cwfd., *Glyptocolastes bruchivorus* Cwfd., *Heterospilus bruchi* Vier., and *H. prosopidis* Vier. The species of *Horismenus*, which have not been determined, are even more closely restricted, some being apparently confined to a single host species.

If the author seems to have ignored the practice of the European authors of giving the family name of this group of beetles as Lariidæ instead of Bruchidæ, and of dividing the genus *Bruchus*, he must plead a lack of the systematic knowledge of the group necessary for placing the different species in their proper genera. To this circumstance also must be attributed the lack of any attempt at a logical arrangement of the species considered. The information given is simply contributed as an addition to the biological knowledge of the group.

The thanks of the writer are due and are herewith extended to Mr. Charles Schaeffer, who determined most of the Bruchidæ, and to Messrs. J. C. Crawford and H. L. Viereck, who determined the parasites.

Bruchus julianus Horn, Proc. Cal. Acad. Sci., Ser. 2, V, p. 410.

This species, the largest of the genus in the United States, was

recorded by Schaeffer (1904) as occurring quite commonly in July on *Acacia flexicaulis* (=*Siderocarpus flexicaule*), with the comment that it undoubtedly breeds in the seed pods of this tree. Specimens in the collection of the National Museum at Washington were reared from the same plant, the so-called Texas ebony. A large series of specimens have been reared by us from three lots of the *Siderocarpus* pods.

The first lot of material was collected by Mr. H. P. Atwater at Corpus Christi, Texas, in November, 1903. Mr. J. D. Mitchell subsequently found it at Harlingen, Texas, August 1, 1906. From this lot the first adults emerged on August 16, and the last on September 11, giving, from the date of collection, a minimum of fifteen and a maximum of forty-one days.

The third lot of pods was collected by Mr. Mitchell at Victoria, Texas, on July 26, 1907. The first adult emerged July 31 and the last recorded on August 18. However, two months later, on October 18, the pods were examined and six living adults found still in the seeds. This gives a maximum period in the seed of at least eighty-four days. The species is apparently single brooded.

From all three of the lots of material many specimens of *Horismenus* sp. were reared. This species is internally parasitic on the larval *Bruchus*, leaving the body of its host and pupating in the cell. Many individuals mature on a single host. Some of the records on this point are as follows, one larva serving as the host of the number of *Horismenus* given in each case: 10, 30, 33, 33, 34, 56, 64. In two cases two parasitized larvae were found in the same seed and the parasites counted together. One pair produced 53 parasites and the other 132. This is the only parasite we have reared from this *Bruchus*.

Bruchus ochreolineatus Fall, Trans. Am. Ent. Soc. XXXVI, No. 2, 1910, p. 186.

This large species was found by the author breeding in the large, distorted pods of a "chapparal" (probably *Mimosa fragrans*) in the Chisos Mountains, Brewster County, Texas, in June, 1908, and in September at Ballinger and Albany, Texas.

In the Brewster County material it was parasitized by *Glyptocolastes bruchivorus* Cwfd., and an undetermined chalcid.

Bruchus quadridentatus Schaeffer, Mus. Brooklyn Inst. Arts and Sci., Science Bul., Vol. 1, No. 10, 1907, p. 304–305.

About forty specimens of what appear to be this species were reared from pods of a plant called by the Mexicans "Tenaza." The author has been unable to ascertain the scientific name of the plant. It is, however, one of the many "chapparals" growing in the semiarid

portion of South Texas. The only lot of material we have had was collected by Mr. J. D. Mitchell at Brownsville, Texas, on November 20, 1907. No exact data were kept by Mr. Mitchell, but the forty adults were recorded as having emerged between January 30 and March 19, 1908.

Between January 30 and August 11, 1908, thirty-five parasites emerged. By far the most abundant was *Urosigalphus bruchi* Cwfd., of which twenty-five specimens were reared. Six of the others were *Heterospilus bruchi* Vier., one *Phanerotoma* sp., two *Glyptocolastes bruchivorus* Cwfd. and the remaining one *Parasierola distinguenda* Kieff.

Among the breeding records of the Department of Agriculture is one referring to this species. Unfortunately the host plant is not given, but two species of parasites were reared. These were a single male specimen of a *Cerambycobius* and two specimens of *Glyptocolastes bruchivorus* Cwfd. The material was collected and reared February 1, 1911, at Brownsville, Texas, by D. K. McMillan.

Bruchus quadrimaculatus Fabricius, Syst. El., II, p. 398.

This species has been repeatedly observed by the writer and other members of the boll weevil laboratory force heavily infesting its normal host, the cowpea. At the laboratory in Dallas, Texas, it was found heavily parasitized by two undetermined chalcids.

It was frequently found visiting the nectaries of cotton plants in the yard.

Chittenden (Yearbook U. S. Dept. Agr., 1898, p. 247.) recorded *Bruchobius laticeps*[2] Ashm. and *Aplastomorpha prattii* Ashm. MS. as attacking this species. The predaceous mite *Pediculoides ventricosus* Newp. is also recorded by him as killing large numbers of the various stages of this *Bruchus* and of *B. chinensis* L.

Bruchus mimus Say, Curc. N. A., p. 2; Leconte Ed., I, p. 260.

On September 12, 1907, Mr. W. D. Pierce found the pods of redbud (*Cercis canadensis*) to have been infested, presumably by a bruchid. The only trace of the insect found were the emergence holes and the "exuviæ of a *Cerambycobius* female and of another parasite." On October 18, 1907 the writer collected a large lot of these pods, from which emerged many specimens of *B. mimus* and its parasites.

The species is a continuous breeder, reproducing on the old pods even within a darkened cage. Thus specimens were emerging as late as October, 1908, from pods of the previous season.

The following species of parasites were reared from this host: *Cerambycobius cyaniceps* Ashm., *Horismenus* sp., and *Glyptocolastes*

[2] Recorded as *B. laticollis* Ashm. which is an erroneous spelling of *B. laticeps* Ashm.

bruchivorus Cwfd. The last is represented by a single female specimen, found dead in the cell of its host in a seed. The *Horismenus* is, so far as is known, peculiar to this host. It breeds singly as a primary parasite. Both *Horismenus* and *Cerambycobius* hibernate within the pods of Cercis in the immature condition, specimens of the former having emerged in our cages as late as March 30 and of the latter March 5.

Bruchus discoideus Say, Journ. Acad., Ser. 1, Vol. III, p. 307.

Three males and one female of this species, sent me by Mr. R. W. Dawson, Lincoln, Neb., are labeled "Working on *Ipomoea leptophylla,* Glen, Sioux Co., Neb., 4000 ft."

Bruchus bivulneratus Horn, Trans. Am. Ent. Soc., 1873, p. 325.

This species, recorded by Riley and Howard (Ins. Life, V, 165) as breeding in the pods of *Cassia marilandica,* was found by the writer at Alexandria, La., in the pods of an undetermined plant (probably *Cassia* sp.) These pods were collected on March 17, 1908, and were of the preceding season's crop. Examination of some of the material disclosed fourteen individuals, ten adults, one teneral adult, and three pupæ, From the pods examined four individuals had already emerged. From another lot of pods collected at the same spot in the following January, no adults had emerged at the time of collection, and the first one did not appear until March 8. The last to emerge from this lot appeared March 22, and the latest adult from the first lot emerged on March 31. The species is, at least on this host plant, single brooded and hibernates in the immature condition. The place of collection of this material at Alexandria is the only locality in which the host plant has ever been found by the writer, and *B. bivulneratus* has been but rarely collected by us in the field. This indicates that it is probably confined in its attack to this plant.

Our records include only one parasite of this species. This is *Horismenus* sp., which breeds singly as a primary parasite. Like its host it hibernates in the pods in the immature condition, probably as a pupa, since all individuals observed in material examined were in this stage. But one specimen was reared from the first lot of pods. This became adult on April 4. From the second lot six specimens were reared, the first on February 6 and the last two on March 22.

Bruchus ulkei Horn, Trans. Am. Ent. Soc., 1873, p. 324.

A single specimen of this species sent me by Mr. R. W. Dawson, Lincoln, Neb., was bred from *Parkinsonia aculeata,* September 9, 1910, from the campus of the University of Arizona.

Bruchus sallæi Sharp, Biol. Cent. Amer., V, p. 475.

This species was of especial interest on account of its being the host of many of the parasites of the boll weevil. Consequently many lots

of infested material were collected and large numbers of the insect and its parasites reared.

Its breeding habit was first found by the author on April 22, 1907, at Victoria, Texas, when a few of the previous season's pods of the huisache (*Vachellia farnesiana*), were found infested by it.[3] At this time the new crop of pods, which were still soft and green, were not infested. The first of the brood in the new pods was reared June 17, 1907, from material collected June 13, at Victoria. A few individuals had already emerged when the collection was made. The pods are first attacked at about the time when they begin to turn dark, and the species is a continuous breeder, carrying on its reproduction, even in the confinement of the breeding cages, as long as there is suitable food. In the field this continues until the new crop of pods has reached the proper stage for infestation.

The egg, which is deposited on the surface of the pod, is oblong oval in shape, .75 mm. long and about half as wide. It is covered with a thin varnish-like substance, which spreads out somewhat beyond the boundary of the egg and fastens it securely to the pod. The larva emerges from the side attached to the pod and burrows in to the seed.

In one large lot of huisache pods this species was accompanied by *B. amicus* Horn.

What proved to be the immature stages of a small variety of *B. sallæi*, as determined by Mr. Charles Schaeffer, were found April 19, 1907, by the author at Corpus Christi, Texas, in the pods of the black chapparal, *Acacia amentacea.* It was associated on this host plant with *Apion subornatum*, the latter species feeding on the substance of the pod and not in the seeds, as is the habit of the *Bruchus*, it is very unlikely that these pods produce more than one generation of the *Bruchus*, as they split open when ripe and scatter their seeds, while the huisache pod is indehiscent.

Six full-grown larvæ of this small form were isolated in small vials on May 15, 1907. On May 22 four had cast the pupal skin, three having already emerged and the other being still soft. This gives a maximum pupal period of eight days.

A single specimen of *B. sallæi* was found by Mr. J. D. Mitchell in a seed of *Gleditsia triacanthos* near Victoria, Texas, on October 9, 1907, its presence there being probably due to the fact that its normal food-plant, huisache, produced almost no fruit during that season in the neighborhood.

[3] Pierce (Journ. Econ. Ent., I, p. 391) has mentioned this species as "*Laria* sp. in *Vachellia*," basing his record on the rearings at the Boll Weevil Laboratory.

Many parasites of this species were reared from the various lots of huisache pods. These include *Urosigalphus bruchi* Cwfd., *Glyptocolastes bruchivorus* Cwfd., *Heterospilus prosopidis* Vier., *Lariophagus texanus* Cwfd., *Cerambycobius cyaniceps* Ashm., *Cerambycobius cushmani* Cwfd., *Cerambycobius bruchivorus* Cwfd., *Eurytoma* (two or more species undetermined), *Catolaccus* sp., *Horismenus* sp., *Microbracon* sp., an undetermined Eupelmid, *Parasierola distinguenda* Kieff., *Cephalonomia hyalinipennis* Ashm., and from one lot many specimens of a very minute chalcid, the last possibly secondary.

Pierce (1908b) has already recorded some of the above records, mentioning the following species as parasitic on "*Laria* sp. in *Vachellia*" (= *B. sallœi*): *Eurytoma tylodermatis* Ashm.,[4] *Cerambycobius cyaniceps* Ashm., *C. cushmani* Cwfd., *C. bruchivorus* Cwfd., and *Urosigalphus bruchi* Cwfd.

Several of the parasitic species were described from specimens reared from this host. This is true of *Glyptocolastes bruchivorus*, *Lariophagus texanus*, and *Cerambycobius bruchivorus*.

Some of these parasites, notably *Urosigalphus*, *Cerambycobius cyaniceps*, *C. cushmani*, and *Horismenus*, repeatedly attacked the *Bruchus* in the pods in the confinement of small breeding cages, so that several generations of parasites were reared under this unnatural condition. A female *Horismenus* was observed by Mr. Pierce to thrust her ovipositor into each end of an empty *Bruchus* egg-shell, evidently trying to locate the hole by which the larva entered the pod. *Urosigalphus*, *Cerambycobius*, *Heterospilus*, and *Lariophagus* have been repeatedly observed running about over the pods searching for places to oviposit. In one lot of pods collected April 22, 1907, *Lariophagus* was still emerging on July 5; in another lot collected June 24, 1907, *Horismenus* was still emerging on July 25 and *Urosigalphus* as late as August 14; in a third lot collected August 10, 1907, there were bred on September 20 four *Glyptocolastes bruchivorus*, three *Cerambycobius cushmani*, three *Urosigalphus bruchi*, one *Catolaccus* sp., and two *Lariophagus texanus;* and in a fourth lot, collected September 6, 1907, there were bred on September 21 one *Cerambycobius cushmani*, four *C. cyaniceps*, six braconids (undetermined, either *Glyptocolastes texanus* or *Heterospilus prosopidis*), three *Catolaccus* and one *Urosigalphus*. The last lot was allowed to remain in the cage over winter, with the result that from March 14 to March 18 six specimens of *Urosigalphus*, five of *Horismenus*, and four of *B. sallœi* emerged.

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[4] *Eurytoma tylodermatis* Ashm. as used by Pierce throughout his paper, "A List of Parasites Known to Attack American Rhynchophora," probably includes more than one species.

There is no doubt but that the parasites hibernated in the pods in the immature condition.

The only lot of pods collected early in the spring, before the new crop had become infested, produced the following species of parasites, which had undoubtedly hibernated in the pods: *Urosigalphus*, *Glyptocolastes*, *Lariophagus*, *Horismenus*, and a bethylid.

Horismenus sp., breeds very abundantly as a primary parasite, ten or more maturing on a single host. This *Bruchus* is its only known host. *Urosigalphus bruchi* is the most abundant parasite of *B. sallœi*, while *Heterospilus prosopidis*, *Glyptocolastes bruchivorus*, *Cerambycobius cyaniceps*, *C. cushmani*, and *Lariophagus texanus* were reared in considerable numbers, all as primary parasites. The others were rare or occasional. All of the parasites except *Horismenus* and probably *Lariophagus* and the minute chalcid breed singly.

Bruchus prosopis Leconte, Proc. Acad. Nat. Sci. Phil., X, 1858, p. 79.

This species was reported by Leconte (loc. cit.) as abundant in the pods of mesquite, *Prosopis juliflora* (=*glandulosa*) and the screw bean, *Strombocarpus*, in the Colorado Desert and by Riley and Howard (Ins. Life, V, 165) as bred from the pods of Prosopis. Several other authors have since recorded it from the same host plants. Our records include only *Prosopis*. In Texas it is almost always accompanied by *B. amicus* Horn. One female specimen of this species, received from Mr. R. W. Dawson, Lincoln, Neb., was taken on *Prosopis velutina* at Oro Blanco, Ariz., August 17, 1910.

The only parasite we have reared from this species is *Urosigalphus bruchi* Cwfd. However, two other species have been recorded as probably parasitic on it. *Heterospilus prosopidis* Vier. was described from specimens bred from "*Bruchus* in *Prosopis juliflora*," and *Glyptocolastes texanus* (Ashm.) Cwfd. was described from specimens "bred from *Prosopis juliflora*, where it was probably parasitic on *Bruchus prosopis*." All of the above species are primary parasites and breed singly.

In addition to the above records notes in the files of the Department of Agriculture record the breeding of the following parasites from this species: *Urosigalphus bruchi* Cwfd., one specimen bred from *Prosopis juliflora*, infested by *B. prosopis* and *B. amicus*, at Kingsville, Texas, June 21, 1909, by D. K. McMillan; many specimens of *Heterospilus prosopidis* Vier., four specimens of an undetermined chalcid, and three of an undetermined proctotrypid with the same data as the *Urosigalphus*; *Heterospilus prosopidis* Vier., three specimens, bred from *B. prosopis* at Brownsville, Texas, June 17, 1908, by D. K. McMillan.

Bruchus amicus Horn, Trans. Am. Ent. Soc., 1873, p. 337.

This species is recorded by Riley and Howard (Ins. Life, V, 165) as breeding in the pods of *Parkinsonia torreyana* and *P. microphylla*. It breeds abundantly in company with *B. prosopis* in mesquite beans (*Prosopis glandulosa*). We have also bred it on one occasion in large numbers in company with *B. sallæi* from pods of huisache. (*Vachellia farnesiana*) from Victoria, Texas. Four specimens, received from Mr. R. W. Dawson, Lincoln, Neb., were taken on *Prosopis velutina* at Oro Blanco, Ariz., August 17, 1910.

No parasites have been definitely reared from this species in our cages, but it is undoubtedly attacked by the typical parasites of other species of *Bruchus* in the same host plants.

Horismenus productus Ashm. was described from specimens reared by C. H. T. Townsend from *B. amicus* at Las Cruces, N. M. Townsend (Can. Ent., XXVII, 1895, p. 277) records this species and also *Eupelmus* (= *Cerambycobius*) *cyaniceps* Ashm. as reared from *B. amicus*.

Bruchus cruentatus Horn, Trans. Am. Ent. Soc., 1873, p. 325.

This species was recorded by Riley and Howard (Ins. Life, V, 165) as breeding in the pods of *Parkinsonia*. We have reared it from pods of *Cassia chamæcrista*, collected in September at Dallas, Texas, by Mr. W. D. Pierce. At this time all four stages were found. No parasites were reared.

Bruchus sp.

This is a small reddish species with abundant gray pubescence. It was found at Marfa, Texas, on June 5, 1908, by Mr. J. D. Mitchell and the author attacking the peculiar bladder-like pods of an *Astragalus* (near *triflorus*). The adults continued to emerge until June 27.

In this lot of material over 70 per cent of the insects were parasitized, the species concerned being *Eurytoma* sp. (undetermined) and an undetermined chalcid, probably a new species, both of which breed singly as primary parasites.

Bruchus placidus Horn, Trans. Am. Ent. Soc., 1873, p. 341.

The pods of two low leguminous plants, probably species of *Astragalus*, were found on September 23, 1908, at Lampasas, Texas, by the writer to have been abundantly infested by this species. On that date, however, most of the insects had emerged, although one specimen bred from each species of plant served to identify the author of the damage. Of these two belated individuals one was found in the pods at the time of collection and the other emerged on October 5. No parasites were reared.

Bruchus limbatus Horn, Trans. Am. Ent. Soc., 1873, p. 326.

A single specimen of this species was reared from a lot of "Tenaza"

pods collected November 20, 1907, at Brownsville, Texas, by Mr. J. D. Mitchell, in company with many specimens of *B. quadridentatus* Schaef.

Several specimens were recently received at the Department of Agriculture from Mr. M. M. High. These were reared by Mr. High from "Ebony" at Brownsville, Texas, March 6, 1911. The "Ebony" is undoubtedly *Siderocarpus flexicaule.*

Bruchus obtectus Say, Curc. N. A., p. 1; Leconte Ed., I, p. 261.

Very little attention was given to this species, only one lot of infested material having been collected. This was part of a sack of badly riddled red kidney beans found by the author in a wholesale grocery house at Shreveport, La. No parasites were secured from this lot.

Chittenden (Yearbook U. S. Dept. Agr., 1898, p. 242) recorded *Cerambycobius cyaniceps* Ashm. and *Bruchobius laticollis*[5] Ashm. as valuable parasites of this species.

Bruchus schrankiæ Horn, Trans. Am. Ent. Soc., 1873, p. 339.

This species, originally described by Horn from *Schrankia uncinata,* was reared from one lot of the pods of a species of "cat-claw" (*Mimosa borealis*) collected May 4, 1907, at Devil's River, Texas, by Mr. F. C. Bishopp. It was associated on this plant with *Apion pyriforme* Sm. On May 4, 1907, a single specimen was bred by the author from a pod of "black chapparal," *Acacia amentacea,* in company with *B. sallœi* and *Apion subornatum.* From the *Mimosa* the first adults emerged May 17, and the last June 8, giving a maximum of thirty-five days and a minimum of thirteen days from the date of collection. No parasites of this species were reared.

Bruchus distinguendus Horn, Trans. Am. Ent. Soc., 1873, p. 336.

This species was mentioned by Blatchley in his "Coleoptera of Indiana" as being reared from *Bracca virginiana.* Our only breeding record was secured by the author on January 10, 1907, at Nacogdoches, Texas, where a few pods of *Rhynchosia latifolia* were found containing the immature stages. A weevil, the adult of which was never secured, also breeds in these pods. Eight adult *B. distinguendus* were reared from the small amount of material obtained, the first two on July 29 and the last three on August 2. This gives minimum and maximum periods from the date of collection of nineteen and twenty-three days respectively. This is probably considerably short of the developmental period, as all the larvæ observed were well grown at the time of collection.

A chalcid of the genus *Chalcis* or a closely allied genus was bred from the material, but its source could not be determined. It was,

[5] Wrong name for *B. laticeps* Ashm.

however, probably parasitic on a lepidopterous larva, the adult of which was not reared.

Bruchus exiguus Horn, Trans. Am. Ent. Soc., 1873, p. 341.

Riley and Howard (Ins. Life, V, 165) record the breeding of this species from *Amorpha fruticosa* in Illinois and Washington, D. C. The writer has found it infesting the seed pods of this plant in a number of localities in Texas and Oklahoma. It is a continuous breeder and specimens can be found in the pods at any season of the year. Our notes are based on material collected by the author at Dallas, Albany, Henrietta, and Bowie, Texas and Ada, Oklahoma, and by Mr. J. A. Hyslop at Washington, D. C.

Every lot of material which was kept over winter in the cages continued to give forth adults well along into the following spring. The first lot obtained was collected at Dallas, Texas, on September 12, 1907. It consisted entirely of the crop of the preceding season, but was abundantly infested. Adults continued to issue from these pods as late as October 10, when the material was thrown away. At the time of collection the *Amorpha* bushes were in bloom, so that the last adults reared emerged nearly a year after the first infestation.

This species is attacked by a number of hymenopterous parasites, the following having emerged in our breeding cages: *Horismenus* sp., *Cerambycobius cyaniceps* Ashm., *Heterospilus prosopidis* Vier., *Glyptocolastes bruchivorus* Cwfd., *Eurytoma* sp., *Microdontomerus anthonomi* Cwfd., *Cerambycobius brevicaudus* Cwfd., *Catolaccus incertus* Ashm., and an undetermined Eupelmid, the female of which is wingless. The first five of these were bred abundantly. Of *C. brevicaudus* only three specimens were reared, of *M. anthonomi* only two, and of the Eupelmid only one pair, which were in copula when removed from the breeding cage.

Three of the species are known as parasites of the boll weevil: *C. cyaniceps*, *M. anthonomi*, and *Eurytoma* sp.

Cerambycobius brevicaudus Cwfd. was described from specimens reared from this host and is known only as a parasite of this host. This is also the only known host of the *Horismenus*.

The four principal parasites were reared from the material almost continuously, many individuals hibernating in the pods in the cages. All of the parasites reared breed singly as primary parasites of the *Bruchus*.

Some of the above records of parasites were published by Pierce (1908b). The species mentioned by him as attacking *B. exiguus* are *Microdontomerus anthonomi* Cwfd., *Cerambycobius brevicaudus* Cwfd.,

C. cyaniceps Ashm., *Catolaccus incertus* Ashm., and *Eurytoma tylodermatis* Ashm.[6]

In addition to the above parasites *Meraporus bruchivorus* Ashm. was described (Bul. Ohio Expt. Sta., Tech. Ser. I, No. 3, p. 161) from specimens reared from this host.

Bruchus ochraceus Schaeffer, Mus. Brooklyn Inst. Arts & Sci., Science Bul., Vol. I, No. 10, 1907, p. 303.

This species was found by the writer at Alexandria and Forbing, La., and Victoria, Texas, infesting the two-seeded pods of a small species of *Vicia* (near. *hirsuta*). The first collection was made at Alexandria on September 14, 1907. At this time most of the pods were still soft and green, and none of the insects had emerged, but examination of some of the pods disclosed adults ready for emergence. This condition at such a late date, together with the fact that the pods scatter their seeds when ripe, would seem to indicate that the species is at most double brooded. That certain individuals of the second generation hibernate in the pods was shown by the fact that a very few pods collected at Alexandria on January 24, 1909, which had not opened, gave forth later one specimen of *Bruchus* and a number of parasites. Also, from nearly every lot collected early in the fall, specimens of both the *Bruchus* and its parasites were reared during the following spring. This indicates a second gėneration, within the breeding cage, of the parasites as well as of the host. The pod is prevented from opening when infested by a full-grown larva or a pupa by reason of the seed being securely fastened to the valves by the larva. The latest date of emergence of this species in the spring was February 12. This specimen, however, emerged from a lot of pods, which was kept in a vial indoors, and is probably somewhat earlier than the normal type of emergence under natural conditions.

The parasite species reared from this host were as follows: *Heterospilus prosopidis* Vier., *Microbracon* sp. *Cerambycobius cyaniceps* Ashm., *C. cushmani* Cwfd., and *Eurytoma* sp. All of these breed singly as primary parasites. The first mentioned is the most abundant, while *C. cushmani* was reared only from the Victoria material. This latter species has, in fact, been reared from any host in only one locality outside of South Texas. This was at Alexandria, La., where a few individuals were reared from the boll weevil, and where a careful, but unsuccessful, search was made by the writer for the native hosts of the parasite. The finding of the breeding habit of *B. ochraceus* was one of the results of this search, the two lots of *Vicia* pods secured at that time having been collected at the edges of the two cotton fields from which *C. cushmani* had been reared. Of *Microbracon* sp. only

[6] See footnote p. 496.

one specimen was reared. Its large size renders its parasitism on the *Bruchus* somewhat doubtful. It was probably parasitic on some other insect, possibly a lepidopteron, the adult of which was not reared. The latest date for the rearing of *Heterospilus* from this host was April 21, for *C. cyaniceps* March 6, while *C. cushmani* emerged in December.

Bruchus compressicornis Schaeffer, Mus. Brooklyn Inst. Arts. & Sci., Science Bul., Vol. I, No. 10, 1907, p. 305.

Bruchus bisignatus Horn, Trans. Am. Ent. Soc., 1873, p. 334.

These two species are considered together for the reason that, though the former is frequently found alone, the latter has never, in our experience, been reared except in company with *B. compressicornis*, and a consideration of the parasites must include both species.

B. compressicornis was found by the writer breeding in the flat, clustered pods of *Acuan illinoensis* on September 18, 1907, at Forbing, La., and in the following summer at Victoria, Texas. We have also reared it from the same plant at Tallulah and other points in eastern Louisiana. From the Victoria lot several specimens of *B. bisignatus* were reared and from the Tallulah material one specimen of this species. Mr. D. K. McMillan found both species breeding abundantly in *Acuan* at El Reno, Okla., in August, 1909.

The first record of the breeding of *B. bisignatus* was published in Insect Life, Vol. V, p. 286, where it is recorded as breeding in the pods of *Desmanthus virgatus* from Mexico. *Acuan illinoensis* was formerly known as *Desmanthus brachylobius*, and the specimens reared by Mr. McMillan are so labelled.

From the material from Forbing, La., which was infested only by *B. compressicornis* and which was very highly parasitized, no adults of the host were reared until the following May 16, from which time they continued to emerge until June 20. The pods infested by this species are prevented from opening in the same manner as the *Vicia* pods are kept closed by *B. ochraceus*.

The very high percentage of parasitism in this lot (97 per cent, based on the recorded rearings) was due entirely to two species: *Heterospilus prosopidis* Vier. and *Cerambycobius cyaniceps* Ashm., both primary parasites. The former was much the more abundant, 107 individuals of this species being reared and 17 of the *Cerambycobius*. *Heterospilus* continued to emerge from the pods of this lot as late as June 20 and *Cerambycobius* until March 7.

The parasites reared at Tallulah, La., were all chalcids. The most abundant species was *Catolaccus hunteri* Cwfd. This was reared in large numbers. One specimen of *Habrocytus piercei* Cwfd. and three of *Cerambycobius cyaniceps* Ashm. were also reared. *Catolaccus*

continued to emerge from one lot of pods of the previous season as late as April 13 and from another until April 27. In both of these lots *B. compressicornis* emerged for some time after June 6. No observations were made from that date until August 30, when the cages were cleaned out and many dead *Bruchus* found.

From the material collected at El Reno, Okla., infested by both species of *Bruchus*, Mr. McMillan reared nineteen specimens of *Heterospilus prosopidis* and seven specimens of an undetermined chalcid. These parasites undoubtedly attack either species of *Bruchus*.

Cœnophanes n. sp. (probably a species of *Heterospilus*) is recorded in Insect Life (loc. cit.) as reared from *B. bisignatus*.

A few specimens of *B. bisignatus* emerged unexpectedly from the material collected at Victoria, Texas, for breeding the parasites of *B. compressicornis*. No parasites were, however, bred from this lot.

Bruchus hibisci Olivier, Ent. IV, p. 21, No. 28, pl. 3, fig. 28a–b.

This is the only species of the genus that we have found which does not attack a leguminous plant. Throughout Louisiana, especially in the low, swampy regions, it is the most commonly collected bruchid. The adults are found visiting a great variety of flowering plants. During the blooming and fruiting season of *Hibiscus*, its host plant, it is very abundant within the involucres. The writer has found as many as twenty-five or thirty adults in the involucre of a single bloom, and they may be reared in very large numbers from the infested capsules or "bolls." In the "bolls" it is sometimes associated with *Conotrachelus fissunguis* Lec.

It is recorded in Insect Life, V, 165 as "bred from seeds of *Hibiscus moscheutos* at Bluffton, S. C., and Washington, D. C.; also from seed of *H.* sp. (*militaris?*) at St. Louis, Mo." The species found to be attacked by it in the writer's experience is *H. militaris*. Among the records in the Department of Agriculture is one referring to this species as being bred from the capsules of *Abutilon abutilon* at Washington, D. C., July 30, 1906, by F. H. Chittenden.[7]

Our notes on this species are based on rearings from three lots of the pods of *H. militaris*. These were collected at Mitchener and Newellton, La., and Eudora, Ark. From the Newellton lot the adults continued to emerge until October 9 and from the Eudora lot until October 14. The earliest record of emergence was in the Mitchener lot, July 31. Unlike most of the members of this family the larva does not seem to prepare an opening through the seed coat, from which

[7] During the present summer (1911) the writer has found the adults and eggs of *B. hibisci* abundant on *Abutilon* at Vienna, Va. The egg is white, about .5 mm. long by about one third as wide, and oblong oval in shape. It is deposited among the pubescence of the *Abutilon* capsule. As has been discovered with other species of the genus, the newly hatched larva has long delicate legs, which are later lost.

to emerge, since when the seeds of the last mentioned lot were examined on July 16, no external evidence of infestation was found.

From the Mitchener lot of material many specimens of *Conotrachelus fissunguis* were reared.

Spermophagus robiniæ Fabricius, Syst. El. II, 1801, p. 397.

We have reared this species from the pods of the honey locust (*Gleditsia triacanthos*) in Texas and Louisiana and of the water locust (*G. aquatica*) in Louisiana. The description of the species by Fabricius gives the host plant as *Robinia pseudacacia*. This is probably an erroneous determination. Our earliest collection of pods of *G. triacanthos* was made on August 15, 1907, at Forbing, La. From this lot the adults began emerging on August 28. Of *G. aquatica* pods, the first lot was collected on September 19, 1907, at the same locality. At this time larvæ, pupæ, and adults were found, but no emergence had taken place. From late summer until well along in the spring specimens can be bred from the pods of either species of locust, our latest record being March 22, 1909, when one adult emerged in a lot of *G. aquatica* pods collected at Shreveport, La., on January 25.

This species is sometimes abundantly parasitized. From it we have reared the following species, all primary: *Heterospilus bruchi* Vier., *Urosigalphus bruchi* Cwfd., *Eurytoma* sp., *Horismenus* sp., *Microbracon* sp., and *Cerambycobius cyaniceps* Ashm. Heterospilus is much the most abundant of these. All of the parasite species mentioned hibernate in the locust pods, probably in the immature condition.

Pierce (1908 b) has already recorded some of the above parasites as attacking *S. robiniæ*: *U. bruchi*, *C. cyaniceps*, and *Eurytoma tylodermatis* Ashm.

Wickham (1895) found the larvæ in honey-locust in October heavily parasitized by *Cœnophanes spermophagi* Ashm. MS., four or five individuals maturing on a single host. He also reared *Horismenus* (*Holcopelte*) *popenœi* Ashm., and records it as probably secondary through *Cœnophanes*.

Caryoborus arthriticus Fabricius, Syst. El. II, p. 398.

Charles Dury (Can. Ent. XIII, 1881, p. 20) recorded this species as breeding in the seeds of palmetto (genus *Sabal*). In 1893 it was again recorded by Riley and Howard (Ins. Life, V, 166) from the same plant. Mr. J. D. Mitchell found it attacking a member of this genus near Brownsville, Texas, in 1907. The adults emerged the following spring, the last appearing on May 30.

Some of the adults deposited eggs on the surface of the seeds. These are opaque white, about one millimeter long, and oval in shape. They are attached to the seed by a small patch of a shellac-like substance.

The fruit of the small palmetto which grows abundantly throughout the swampy regicns of Louisiana was found to be infested by this species at Tallulah, La. The only lot of material was collected January 2, 1910, by Mr. V. I. Safro. A note made by him is as follows: "In emerging from the berries the Bruchid makes a clean, circular cut in the surface of the berry, pushes this 'lid' off, and emerges. The hole thus formed is about three-sixteenths of an inch in diameter. It extends almost to the opposite side of the berry.

In order to bring the present knowledge of the host-plants and parasites of the North American species of Bruchidæ together the following brief statement is given. The numbers and letters in parentheses refer to the bibliography following. Asterisks indicate records obtained by the "Boll Weevil Investigation" and other records published for the first time in the present paper.

TABLE OF HOSTS AND PARASITES OF BRUCHIDÆ

Species	Host-plants	Parasites
Caryoborus arthriticus Fab.	Palmetto (*Sabal*) seeds. (16c, 7,*)	
Spermophagus robiniæ Fab.	Gleditsia triacanthos. (16c, 4, etc.,*)	Heterospilus bruchi Vier. (*)
	G. aquatica. (*)	Cænophanes spermophagi Ashm. MS. (22)
	Robinia pseudacacia. (8) (? *)	Urosigalphus bruchi. Cwfd. (14b*)
	"Black and honey locust." (3)	Microbracon sp. (*)
		Cerambycobius cyaniceps Ashm. (14b*)
		Eurytoma tylodermatis Ashm. (14b)
		E. sp. (*)
		Horismenus popenœi Ashm. probably secondary through Cænophanes spermophagi. (23)
		Horismenus sp. (*)
S. pectoralis Shp.	Beans. (5c)	
[=Zabrotes. (5c)]	Cowpeas. (5c)	
	Mexican beans. (18b)	
S. vitis Schaeff.	"Taken only on grape vines." (18b)	
Bruchus alboscutellatus Horn.	Ludwigia alternifolia. (16c, 10)	Bruchophagus mexicanus Ashm. (1c, 21a)
	L. palustris. (3)	
	Glycyrrhiza lepidota. (21a)	
B. amicus Horn.	Parkinsonia torreyana. (16c)	Cerambycobius cyaniceps Ashm. (21a)
	P. microphylla. (16c)	Horismenus productus Ashm. (1a, 21a)
	Prosopis glandulosa. (21b,*)	"Probably attacked by parasites of *prosopis* and *sallæi*." (*)
	P. pubescens. (21a)	
	P. velutina. (*)	
	Vachellia farnesiana. (*)	
B. aureolus Horn. (smaller form.)	"On flowers of Astragalus sp." (11a)	
B. bisignatus Horn.	Desmanthus virgatus. (16d)	Cænophanes n. sp. (16d)
	Acuan illinoensis. (*)	[=Heterospilus. (14b)]
		"Probably same parasites as *compressicornis*." (*)
B. bivulneratus Horn.	Cassia marilandica. (16c)	Horismenus sp. (*)
	Cassia (?) sp. (*)	
B. chinensis L.	Beans. (16b, 16c)	"Two or more chalcidid parasites." (5b, 5c)
[=Pachymerus. (5f)]	Chinese beans. (16c)	
	Table beans. (5c)	
	Cowpeas. (5c, 5d, 5f)	

TABLE OF HOSTS AND PARASITES OF BRUCHIDÆ—*Continued*

Species	Host-plants	Parasites
B. chinensis L. (*continued*)	Phaseolus radiatus. (5c) Cajanus indica. (5c) Cicer arietinum. (5c) "Kolu." (5c) "Muneta." (5c)	
B. compactus Shp.	?Ipomœa sp. (16c)	
B. compressicornis Schæff.	Acuan illinœnsis. (*)	Heterospilus prosopidis Vier. (22b see footnote 1,*) Cerambycobius cyaniceps Ashm. (*) Catolaccus hunteri Cwfd. (*) Habrocytus piercei Cwfd. (*) Undetermined chalcid. (*)
B. cruentatus Horn.	Parkinsonia. (16c) Cassia chamæcrista. (*)	
B. desertorum Lec.	Prosopis. (13) Strombocarpus. (13) S. pubescens. (11) Plant No. 1108 (Palmer). (16c)	
B. discoideus Say.	Ipomœa. (15a) Ipomœa leptophylla. (*)	
B. discolor Horn.	Prosopis. (21b) Parkinsonia. (21b) Cassia rœmeriana. (9)	
B. distinguendus Horn.	Cracca virginiana. (3) Rhynchosia latifolia. (*)	
B. exiguus Horn.	Amorpha fruticosa. (16c, 14a, 3,*)	Heterospilus prosopidis Vier. (22b,*) Glyptocolastes bruchivorus Cwfd. (*) Microdontomerus anthonomi Cwfd. (14b,*) Eurytoma tylodermatis Ashm. (14b) Eurytoma sp. (*) Cerambycobius cyaniceps Ashm. (5a, 14b,*) C. brevicaudus Cwfd. (6b, 14b,*) Eupelmid. (*) Meraporus bruchivorus Ashm. (1b) Catolaccus incertus Ashm. (14b,*) Horismenus sp. (*)
B. flavicornis Shp.	Abutilon holosericeum. (21b)	
B. fraterculus Horn.	Hedysarum boreale. (16c) Glycyrrhiza lepidota. (2)	Bracon xanthostigma Cr. (2) [= Microbracon mellitor Say.] Eurytoma sp. (2) Pteromalid. (2)
B. hibisci Ol.	Hibiscus moscheutos. (16c, 3) H. sp. (militaris ?) (16c) H. militaris. (*) Abutilon abutilon. (*)	
B. julianus Horn.	"Undoubtedly breeds in seed-pods of Acacia flexicaulis." (18a) Siderocarpus flexicaule. (*)	Horismenus sp. (*)
B. leucosomus Shp.	Ipomœa. (16c)	
B. limbatus Horn.	"Tenaza" pod. (*) Siderocarpus flexicaule. (*)	
B. longicollis Fabr.	Canavalbia n. sp. (16c)	
B. longistilus Horn.	"Said to breed in seeds of mallows." (3)	
B. mimus Horn.	Cercis canadensis. (*)	Gylptocolastes bruchivorus Cwfd. (*) Cerambycobius cyaniceps Ashm. (*) Horismenus sp. (*)
B. obsoletus Say.	"From seeds of an *Astragulus* in August in company with *Apion segnipes*." (17)	

TABLE OF HOSTS AND PARASITES OF BRUCHIDÆ—*Continued*

Species	Host-plants	Parasites
B. obsoletus Say (*continued*)	Tephrosia virginiana. (15b, 16b, 5e) T. spicata. (12)	
B. obtectus Say. [= Acanthocelides. (5f)]	Cultivated beans. (Many authors.) Cowpeas. (5d) Lima beans. (16a) Peas. (19) Lentils. (19) Chick peas. (19) Lathyrus sativus. (19)	Cerambycobius cyaniceps Ashm. (5c) Bruchobius laticollis Ashm. (5c) [= B. laticeps Ashm. (*)]
B. ochraceus Schaeff.	Vicia sp. (near hirsuta.) (*)	Heterospilus prosopidis Vier. (22b see foot note 2, *) Microbracon sp. (Doubtful *) Eurytoma sp. (*) Cerambycobius cyaniceps Ashm. (*) C. cushmani Cwfd. (*)
B. ochreolineatus Fall.	Mimosa fragrans. (? *)	Glyptocolastes bruchivorus Cwfd. (*) Undetermined chalcid. (*)
B. pisorum L. [= Laria. (5f)]	Peas. (Many authors.)	Bruchobius laticollis Ashm. (14b) [= B. laticeps Ashm. (*)]
B. placidus Horn.	"Two low, leguminous plants, probably species of Astragalus." (*)	
B. prosopis Lec.	Prosopis glandulosa. (13, many authors, *) Strombocarpus. (13, many authors.) Prosopis velutina. (*)	Urosigalphus bruchi Cwfd. (6a, 14b,*) Glyptocolastes texanus (Ashm.). Cwfd. (6d see footnote 3) Heterospilus prosopidis Vier. (22b) Undetermined chalcid. (*) Undetermined proctotrypid. (*)
B. protractus Horn.	Prosopis glandulosa. (16c)	
B. pruininus Horn.	Olneya tosata (= tesota). (16c) Ironwood tree (11) (probably *O. tesota*) (16c)	
B. quadridentatus Schaeff.	"Tenaza" pod. (*)	Glyptocolastes bruchivorus Cwfd. (*) Urosigalphus bruchi Cwfd. (*) Phanerotoma sp. (*) Heterospilus prosopidis Vier. (22a see footnote 4,*) Cerambycobius sp. (*) Parasierola distinguenda Kieff. (*)
B. quadrimaculatus Fab. [= Pachymerus. (5f)]	Black-eyed table beans. (16c) Cowpeas. (Many authors,*) Peas. (5c)	Aplastomorpha prattii Ashm. MS. (5c) Bruchobius laticollis Ashm. (5c) [= B. laticeps Ashm. (*)] "Three species of parasitic Pteromalinæ." (5b) "Two undetermined chalcids." (*)
B. rufimanus Boh.	Pea pods from Switzerland. (11) Peas. (16c) Beans (especially Windsor varieties). (5c)	
B. sallæi Shp.	Vachellia farnesiana. (14b,*) Acacia amentacea. (*) Gleditsia triacanthos. (*)	Urosigalphus bruchi Cwfd. (14b,*) Glyptocolastes bruchivorus Cwfd. (6d see footnote 5,*) Heterospilus prosopidis Vier. (22b see footnote 6,*) Microbracon sp. (*) Lariophagus texanus Cwfd. (6c see footnote 7,*) Cerambycobius cyaniceps Ashm. (14b,*) C. cushmani Cwfd. (14b,*)

TABLE OF HOSTS AND PARASITES OF BRUCHIDÆ—*Concluded*

Species	Host-plant	Parasite
B. sallæi Shp. (*continued*)		C. bruchivorus Cwfd. (6b see footnote 8, 14b,*)
		Undetermined Eupelmid. (*)
		Eurytoma tylodermatis Ashm. (14b)
		E. spp. (*)
		Catolaccus sp. (*)
		Horismenus sp. (*)
		Parasierola distinguenda Kieff. (*)
		Cephalonomia hyalinipennis Ashm. (*)
		"Very minute chalcid possibly secondary." (*)
B. schrankiæ Horn.	Schrankia uncinata. (11)	
	Mimosa borealis. (*)	
B. triangularis Say.	"Mexican seeds the size of palmetto but concave within" (17)	
B. ulkei Horn.	Broad podded Palo berde (*Parkinsonia.*) (16c)	
	Parkinsonia aculeata. (*)	
B. uniformis Lec.	Prosopis. (12, 13, 16c)	
	Strombocarpus. (12, 13, 16c)	
B. sp.	Astragalus sp. (near *triflorus*). (*)	Eurytoma sp. (*)
		Undetermined chalcid. (*)
B. n. sp.	Prosopis pubescens. (16c)	
B. sp. (not reared).	Phaseolus pauciflorus. (16c)	
B. sp. (larvæ only observed).	Loco weed. (16c)	
B. (?) sp. (eggs on pod).	Acacia filicina. (16c)	
B. (No. 4324)	Plant No. 305 (Palmer). (16c)	
B. n. sp.	Prosopis. (21b)	
B. sp.	Lotus sp. (21a)	Bruchophagus mexicanus Ashm. (21a)
B. sp.		Bruchophagus borealis Ashm. (1c)
Laria sp. in *Vachellia*. (14b) [=Bruchus sallæi. (*)]		

[1] Hunter No. 1455 mentioned in the description of this species refers to *B. compressicornis* and *B. bisignatus;* but as *bisignatus* was not reared from the locality mentioned, the specimens of *H. prosopidis* were parasitic on *B. compressicornis.*

[2] Hunter No. 1454 mentioned in the description refers to *B. ochraceus.*

[3] In his redescription of this species Crawford gives the following: "Type specimens bred from *Prosopis juliflora,* where it was probably parasitic on *Bruchus prosopis.*"

[4] Hunter No. 1700 mentioned in the description of this species refers to *B. quadridentatus.*

[5] Although the type specimens of this species are labelled "Parasite of *Bruchus prosopis*" as indicated in the description, the other labels on the pins show that they were bred from *B. sallœi.* The discrepancy is due to an erroneous determination of the host.

[6] The paratypes recorded in the description as bred from *Bruchus prosopis* were so labelled through a mistaken determination of the host.

[7] The type specimens of this species are labelled as indicated in the description as parasitic on *Laria* (*Bruchus*) *prosopis.* This was, however, an erroneous determination of the host. The other labels on the pins show the host to have been *B. sallœi.*

[8] The description of this species records the types as having been "bred from *Bruchus* sp. on *Vachellia.* The *Bruchus* sp. is *B. sallœi.*

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SCALE INSECT PARASITISM IN CALIFORNIA

By H. J. Quayle

More activity has been manifested in the importation and propagation of Coccid parasites in California than in any other place in the world. The State Horticultural Commission has been active in this work ever since the introduction of *Novius cardinalis* from Australia in 1889. During this time much good work has been done and several importations have been successfully established in the State. In most of these cases of successful introductions it is assumed that the Bureau of Entomology at Washington played an important part, and usually has taken the initiative. This paper will not review the history of this work, but will present a brief account of the present status of scale parasitism in the State, which will include the native species as well as the importations.

SAN JOSÉ SCALE

(*Aspidiotus perniciosus* Comst.)

The statement is frequently made that the San José scale is no longer a pest in California because of its parasitic enemy, *Aphelinus fuscipennis* How. But this is based upon no studies whatever and in most cases is merely an inference. While the writer has accumulated no extensive data on the amount of this parasitism, what has

been obtained from several different sections of the State during the last five or six years does not show that the parasite in question is an important factor in keeping the scale in check.

Aphelinus fuscipennis How. is probably the commonest species attacking the scale in the State, while *A. mytilaspidis* is also frequently met with. Usually the number of these issuing has been small in comparison with the number of scales. We have found no such numbers, for instance, as Johnson found in Maryland some years ago. Very large numbers issued from his material and it is presumed that the percentage ran high.

It is true that in the Santa Clara Valley where the San José scale first started in this country, it is no longer regarded as a serious pest, but further data are necessary to prove that parasites are responsible for this condition. A very considerable amount of the lime sulphur spray is used in the State each year and chiefly against this scale, and the general efficiency of this wash has done more than anything else to allay the fears that were formerly held against the insect. But where neither the parasites are present in sufficient numbers nor has the wash been applied, the scale no longer occurs in alarming numbers as formerly; and what is true of the Santa Clara Valley is true in many other parts of the State. Again we have seen apple, pear and plum trees practically killed by this scale as late as this present year.

THE RED SCALE

(*Chrysomphalus aurantii* Mask.)

At the present time *Aphelinus diaspidis* How. is the most widely distributed and abundant parasite of the red scale in the State. Counts made on large numbers of this scale show that the percentage parasitized varies from 1 or 2 per cent to 15 or 20 per cent. *Aspidiotiphagus citrinus* Craw. also occurs in some numbers, but the highest percentage found was with the yellow scale as given below. Other parasites recorded from this scale in the State are: *Prospaltella aurantii* How., *Signiphora occidentalis* How., and *Aphycus immaculatus* How.

THE YELLOW SCALE

(*Chrysomphalus aurantii* var. *citrinus* Coq.)

The most important parasite of this scale is *Aspidiotiphagus citrinus* Craw. While it attacks the red scale, it has been most frequently met with and occurs in largest numbers on the yellow. Yellow scale material has been obtained in several places in the southern California citrus belt with no, or little, evidence of the parasite, while in others as high as 40 per cent has been obtained. But it is on

the citrus trees of the Sacramento Valley where this parasite is to be found in the greatest numbers. Examination of 5,000 scales recently received from that section showed 67 per cent parasitized.

THE BLACK SCALE

(*Saissetia oleae* Bern.)

Scutellista cyanea Motsch. outranks all other enemies of the black scale in California. This is the first of the parasites thus far mentioned that has been intentionally introduced. It was first found in Europe and later in South Africa, from which country it was introduced into California in 1900. As high as 75 and 80 per cent of the black scales may be found with the exit holes of Scutellista. The eggs of the scale are consumed by this parasite, while the others mentioned above live either in or on the body of the scale insect as endoparasites or ectoparasites, *Aspidiotiphagus* being an example of the former and *Aphelinus* of the latter. *Tomocera californica* How. is another egg parasite of the black scale, but is not nearly so abundant as is the Scutellista. Less than 10 per cent is the maximum number taken in recent years, though thirty years ago it was said to be as abundant as Scutellista is today. *Aphycus flavus* How., attacks the young black scales and also the males but never in very large numbers. *Coccophagus lecanii* Fitch., and *C. lunulatus* How., have also been reared from the black scale.

SOFT BROWN SCALE

(*Coccus hesperidum* Linn.)

This species is one of the most abundantly parasitized scales in the State, and is no doubt often kept in check through their attacks. All of the species, so far as known, are also native parasites. Of three or four species it is difficult to say which is the most important, since different species may predominate in different sections, or first one and then another attain the ascendency in the same section. The four most important and probably in the order named are: *Encyrtus flavus* How. *Aphycus flavus* How., *Coccophagus lunulatus* How., and *C. lecanii* Fitch. Mr. P. H. Timberlake has reared four other parasites from this scale, two of which are secondary, but these are less common than the four named.

EUROPEAN FRUIT LECANIUM

(*Lecanium corni* Bouche.)

The most important parasite attacking this scale is *Comys fusca* How. Others as *Coccophagus lecanii* and *Aphycus flavus* attack the

scale in its younger stages but are less numerous than *Comys fusca.* This scale is also said to be kept in check through the work of the above parasite, A statistical study of the parasitism of this scale made a few years ago[1] showed that, in 67,000 scales examined in all parts of the state, the maximum in any orchard was 47.6 per cent, and the minimum in any orchard 1.9 per cent, with a general average for the whole state of 12 per cent. This represents but a single season's observations and no doubt in some cases may run higher than that given, but nevertheless it is not within the facts to state that this scale is held in check by *Comys fusca.*

PURPLE SCALE

(*Lepidosaphes beckii* Newm.)

This scale has always been considered freer from parasites than any of the scales of economic importance in the State. While this, in general, is true and purple scale material will usually be obtained with no evidence of parasitism, yet in certain sections a considerable amount of parasitism may occur. The only parasite taken from this scale thus far, is *Aspidiotiphagus citrinus* Craw. A few cases have been found where the maximum parasitization ran between 40 and 50 per cent.

COTTONY CUSHION SCALE

(*Icerya purchasi* Mask.)

A parasite that was introduced at the same time as *Novius cardinalis* to prey upon the cottony cushion scale was the dipterous species *Cryptochœtum icerya* Will. On account of the overshadowing results of *N. cardinalis* this internal parasite was largely forgotten. At the present time it is not uncommon to find this parasite, but it is still much less important than the beetle. The heaviest parasitism by *Cryptochœtum* was observed on cottony cushion scale infesting an acacia tree, and without making actual counts, the percentage seemed to run at probably 50 or 60 per cent.

PREDACEOUS ENEMIES

Coccinellids, while not coming within parasitic enemies in the narrower sense, are often nevertheless included, and a few will be here briefly considered.

The one importation that stands preëminently above all others is *Novius cardinalis* concerning which every entomologist is familiar. The cottony cushion scale is no longer an important pest in the State,

[1] Science, May 15, 1908.

and chief credit for this is usually given to the beetle. There are cases, however, where for some reason or another, the beetle has not been able to prevent the scale doing very considerable injury to the tree; and there are also cases where the scale is harmless and where there are no beetles.

The most important Coccinellid attacking the black scale is *Rhizobius ventralis* Black, which was introduced at the same time as *cardinalis*. This beetle and its larva feed upon the eggs and younger stages of the scale and while very common has never been seen in large numbers. Another species of the genus, *Rhizobius lophanthæ* Blaisd. is the most important Coccinellid attacking the red, yellow and purple scales in the State. This species was first described from California, but it appears that it was imported along with several others and that it was lost track of for some time. In a grove in San Diego County where the owner was assured his red scale was kept in check by a species of *Aphelinus*, an examination of 2,000 scales showed that 3.3 per cent were attacked by *Aphelinus*, 2.2 per cent by *Aspidiotiphagus* and nearly 23 per cent by *Rhizobius lophanthæ*. Greater actual evidence of the work of Coccinellids was shown in this case than any that has come to our notice. Coccinellids and other predaceous enemies may, of course, consume many of the young scales and eggs, and of which no evidence remains, but we are here considering only the attacks on the fixed scales. The Coccinellid, *Cryptolæmus montrouzeri* Muls. another of Koebele's introductions, is the most important species attacking the citrus mealy bug *Pseudococcus citri* Risso, at the present time. This beetle often appears in large numbers and sometimes greatly reduces the number of mealy bugs, but the effects of the beetle are too irregular, and the trees are never free from the sooty mold fungus. There are several species of native Coccinellids that may feed on scale insects but these need not be considered here.

CONCLUSION

With the exception of the soft brown scale, the cottony cushion scale and probably the mealy bug, the insects mentioned in the foregoing pages are the most serious scale pests attacking citrus and deciduous fruit trees in the State. In the citrus belt of southern California more than half a million dollars are expended annually in fumigating and spraying for the black, red, yellow and purple scales. More fumigation is practiced in proportion to the acreage than ever before. Of the four scales mentioned, the black is probably the most important. Of the scales attacking deciduous trees, the San José and Apricot or European Fruit Lecanium are the most

important. While the San José is very much less virulent than formerly, the quantity of lime sulphur applied to control it each year is very considerable; and more spraying is done to control the apricot scale than ever before.

Of the parasites discussed, two—*Scutellista cyanea* and *Cryptochætum icerya*—have been introduced. Of the Coccinellids mentioned all have been introduced. While it should not be claimed that these parasitic and predatory insects are not of considerable service, yet if they are to be judged rigidly on results in commercial orchards, they cannot be rated very highly. The writer thoroughly believes in making all possible use of natural enemies to control injurious species, but at the same time he cannot concur in the belief that most scale insects in California are so controlled.

TEST SPRAYINGS FOR THE GLOOMY SCALE (CHRYSOMPHALUS TENEBRICOSUS COMST.)

By Z. P. METCALF, *State Department of Agriculture, Raleigh, N. C.*

The Gloomy Scale is the most important insect enemy of shade trees in North Carolina, and is well distributed over all this State south and east of the mountains. Its importance is due to two factors: the enormous rapidity with which it breeds and the fact that it is all but completely confined to the soft maples which have been so largely used for shade purposes in our cities and towns. The following tabulated results of careful tree to tree inspection of the maples in portions of Raleigh and Red Springs will serve to make this clear.

RALEIGH. NEWBERN AVENUE AND EDENTON STREET

Name of Tree	Total number of trees	Not infested	Infested	
			Slightly	Badly
Silver Maple	18	5	4	9
Red Maple	39	13	9	17
Sugar Maple	98	98	0	0
Norway Maple	3	3	0	0
Box Elder	1	1	0	0

RED SPRINGS. MAIN STREET AND ADJACENT LAWNS

Name of Tree	Total number of trees	Not infested	Infested		
			Slightly	Moderately	Badly
Silver Maple	28	0	9	8	11
Red Maple	6	0	1	4	1
Southern Red Maple	1	0	1	0	0
Sugar Maple	1	1	0	0	0

These results have been verified by more or less extensive inspections in all of the larger towns of the State, and while a few hard maples have been found infested with the Gloomy Scale, our inspections would show that hard maples are at least highly resistant to the attacks of this scale. We have frequently found a hard maple entirely free from Gloomy Scale growing between two soft maples which were dying from its attacks. This suggests that the present condition will naturally correct itself in time, because people will cease to plant the quick growing soft maples and set in their stead the slow growing resistant hard maples. In this connection the following list of host plants which have come under our own observation is given:

Apple, (Pyrus malus L.) Several young trees growing under the overhanging branches of badly infested red maples found slightly infested.

Red Maple. (Acer rubrum L.) Generally infested.

Silver Maple. (Acer saccharinum L.) Uniformly and badly infested.

Sugar Maple. (Acer saccharum Marsh.) A few scattering individuals found infested, mostly very slightly.

Box Elder. (Acer negundo L.) A few infested.

Buckeye. (Æsculus glabra Willd.) Slightly infested.

Japanese Chestnut. (Castanea sativa.) Badly infested.

Sycamore. (Platanus occidentalis L.) Slightly infested

Water Oak. (Quercus nigra L.) A single tree slightly infested.

White Oak. (Quercus alba L.) A few trees slightly infested.

Iron-wood. (Carpinus caroliniana Walt.) A single badly infested tree.

Willow. (Salix sp.) A small badly infested tree found along a stream in Lincoln County.

Cottonwood. (Populus deltoidea Marsh.) Slightly infested tree.

American Elm. (Ulmus americana L.) Slightly infested.

When our attention was first called to the destructive work of the Gloomy Scale, it was our belief that home-made lime-sulphur (15–15–50 or 15–15–30) or kerosene emulsion at 15, 20 or 25 per cent oil would effectively control it, therefore during 1908 and 1909 various experiments were tried as follows:

Home-made Lime-sulphur (15–15–50). Trees were sprayed in mid December and late February. Some benefits but not a satisfactory remedy.

Home-made Lime-sulphur (15–15–30). Trees were sprayed in mid December and the trees did better after the spraying, but it was not a satisfactory remedy.

Kerosene Emulsion (25 per cent oil). Trees were sprayed in late February. Not a satisfactory remedy, for practically no scale were killed.

Kerosene Emulsion (20 per cent oil). Same as for 25 per cent oil.

Kerosene Emulsion (15 per cent oil). Trees sprayed in early May. No benefits derived from this spraying.

After these home-made remedies had proven so entirely unsatisfactory, we determined to try all of the better known commercial preparations during 1910. A number of home-made preparations were also tried. Most of these mixtures have been previously recommended for the San José scale, but had been abandoned for the home-made lime-sulphur wash. These experiments were divided into three groups. The first series of trees (I) were sprayed in late December while the trees were dormant. The second series of trees (II) were sprayed in late February while the sap was rising and just when the buds were beginning to swell. The third series (III) were sprayed in early May while most of the first brood of young were crawling about or had just settled on the limbs.

The results of these experiments are given herewith.

COMMERCIAL

Insecticides	Strength	Time		
		Winter I	Spring II	Summer III
Scalecide	1–8	excellent	excellent	
	1–10	excellent	excellent	
	1–12	very good		
	1–50			poor
Orchard Brand soluble oil	1–5	excellent		
	1–8	excellent	excellent	
	1–10	good	good	
	1–50			fair

COMMERCIAL—*Continued*

Insecticides	Strength	Time		
		Winter I	Spring II	Summer III
Orchard Brand lime-sulphur	1–5	fair		
	1–8	poor	poor	
	1–10	poor	poor	
	1–25			very poor
Scaleoil	1–8	good		
	1–10	good		
	1–30			poor
	1–40			poor
Grasselli's lime-sulphur	1–5	fair		
	1–8	fair	fair	
	1–10	poor	poor	
	1–25			poor
Sherwin-Williams lime-sulphur	1–8		fair	
	1–10		poor	
	1–25			poor
Sherwin-Williams soda-sulphur	1–25			poor
Rex lime-sulphur	1–10		fair	
	1–25			poor
Target Brand scale destroyer	1–8	excellent	excellent	
	1–10	very good	good	
	1–12	good		
	1–40			poor
Spray-on	1–10		excellent	
	1–12		excellent	
	1–50			fair
One-for-all	1–8		very good	
	1–25			poor
Bowker's lime-sulphur	1–5	fair	fair	
	1–8	fair	fair	
	1–35			fair
Bowker's tree soap	1 lb. to 1 gal. water			fair
Whale Oil soap (Good's potash No. 3)	1 lb. to 1 gal. water			fair
Bowker's insect emulsion	1–15			poor
Niagara Brand lime-sulphur	1–8		good	
	1–10		fair	
	1–25			poor
Scale clean	1–10		excellent	
	1–12		good	
	1–30			poor

COMMERCIAL—*Concluded*

Insecticides	Strength	Time Winter I	Spring II	Summer III
Scalime	1–5		poor	
	1–8		poor	
	1–25			fair
San-U-Zay	1–10		excellent	
	1–12		good	
	1–30			poor
Bogart's sulphur compound	1–5		fair	
	1–8		fair	
	1–25			fair
Pratt's carboline	1–25			fair

Home-made

	Winter I	Spring II	Summer III
Pure Kerosene, tested for its killing properties	poor	tree killed	
Kerosene emulsion: 40%	fair	fair	
50%	fair	fair	
60%	fair	tree killed	
30%			poor
Cotton Oil emulsion (Cooley's formula)	fair	fair	
Linseed Oil emulsion (Cooley's formula)	fair	fair	

Carbolic Kerosene Emulsion

1 lb. soap,
30 gals. water,
3 gals. kerosene,
3 gals. carbolic acid (crude).

Kerosene emulsion made as usual with the addition of the carbolic acid, and the whole thoroughly emulsified. III poor.

The trees used for these experiments were inspected and the relative state of their infestation was ascertained as carefully as possible before commencing the spraying. After the trees were sprayed, they were inspected at intervals of two or three months for a year and a half. In this way we were able to determine not only the immediate effects upon the trees, but also the results on the tree as a whole. In making our inspection more attention was paid to the relative benefits to the whole tree than to careful counts and estimates of the per cent of scale killed.

Roughly speaking "excellent" in the above report means above 95

per cent of the scale killed. "Very good" means from 90 to 95 per cent of the scale killed. "Good" means from 85 to 90 per cent. "Fair" means from 75 to 85 per cent. "Poor" means from 50 to 75 per cent. "Very poor" means less than 50 per cent. In our experience too much dependence cannot be placed on counts of a thousand scale unless they are drawn carefully from all portions of the tree. Careful observations have shown that the normal mortality of the Gloomy Scale varies from nothing to more than 90 per cent on different parts of the same tree, so that it would be possible for one to count a thousand scale on an untreated tree and estimate that it had done better than a tree which had been carefully sprayed with the best mixture known at the present time. Careful inspections show that the critical points for inspection purposes are the bases of the new growth and protected crotches. However a successful treatment always makes itself evident in the appearance and general vigor of the tree, the growth of the new wood and the expansion of the bark. The critical inspections, however, were the ones made in late May when practically all of the young of the first brood had settled and become permanently attached to the branches. The pale grayish young were then very conspicuous among the old black scales and their relative abundance at that time indicated very clearly the number of old scale that were still alive,

From the above tests it seems safe to conclude that any of the soluble oils at 1 to 8 or 1 to 10 are satisfactory remedies for the Gloomy Scale if used while the tree is dormant, one application being sufficient for several years where the scale is slight or moderate. Where the scale is bad two or more applications are advisable. Better results were obtained where the tree was sprayed twice in the same year than where it was sprayed only once.

None of the commercial lime sulphur washes were as satisfactory for controlling the Gloomy Scale as the soluble oils. This we believe is accounted for by the fact that the dorsal scale of this insect is thicker and applied more closely to the ventral scale than is the case in the San José scale. Our observations would lead us to believe that the oils owe their superior killing powers to the fact that they remain moist much longer than the lime-sulphur preparations and are thereby enabled to creep in between the dorsal and ventral scales. The corrosive lime-sulphur washes do not seem to be able to penetrate the thick dorsal scale of this insect. Some of the lime-sulphur washes gave fair results and if spraying for the Gloomy Scale could be repeated year after year, as in the case of the San José scale, they might be recommended. But with shade trees this is usually not practicable.

None of the spring applications were at all satisfactory, and it was

impossible to see that any of the trees sprayed in the spring had been benefited to any marked degree. This we believe is due to the fact that the breeding period of the Gloomy Scale is quite protracted and while the weaker spray mixtures which can be used in the summer without injuring the leaves will kill the young unprotected scale, they are not strong enough to kill the old scale which later gives birth to more young.

Nothing in this report, however, is to be construed as having any bearing upon the value of the various mixtures tried as San José scale remedies.

The writer acknowledges his indebtedness to Mr. S. C. Clapp, field inspector of this office, for his assistance in inspecting the sprayed trees.

THE PYRALID (OMPHALOCERA DENTOSA GROTE), A PEST OF BARBERRY HEDGES

By W. E. BRITTON, *Agricultural Experiment Station, New Haven, Conn.*

On August 12th, 1908, Dr. F. P. Gulliver of Norwich, Conn., sent to the station some curious black and white caterpillars which were feeding upon the leaves of common barberry, *Berberis vulgaris* Linn. This plant, though introduced from Europe, has become naturalized in New England and is far more common in Connecticut than the native species *B. canadensis* Pursh. The writer was away on a vacation, and his assistant, Mr. Walden, who was in charge of the department, not recognizing the caterpillars, wrote to Doctor Gulliver asking him to send more material, which he kindly did. The writer examined the capterpillars on his return September 1st, but they were entirely unfamiliar to him. In his experience of fourteen years in the State he had not at that time ever seen the species before. A few specimens were inflated, and the others placed in the breeding cages for the purpose of rearing the adults, but none were obtained. The following season the insect was not observed by any one connected with this office.

In 1910, however, this insect was more abundant than previously, and a number of caterpillars were found feeding upon not only the common barberry, *B. vulgaris* and its purple-leaved form, but also on the Japanese barberry, *B. thunbergii* D. C. which is used rather extensively for hedges, though not as commonly as California privet and on another species of barberry. Enough material was secured in 1910 to enable us to rear the adults, and both sexes were obtained.

During the annual task of inspecting nurseries the work of this

insect was observed in 1910, especially about New Haven, and in 1911 its work was again noticed.

Habits and Injury

The adults emerged in the insectary from April 10th to 20th, but they do not appear in the open until about the first of July. On July 3d, 1911, specimens were collected by the writer on the screen door of his house, the moths having been attracted by the light in the hall. As there is a low hedge of Japanese barberry in front of the house and only a few feet away, they were doubtless there for the purpose of ovipositing, and later a few caterpillars were found on this hedge.

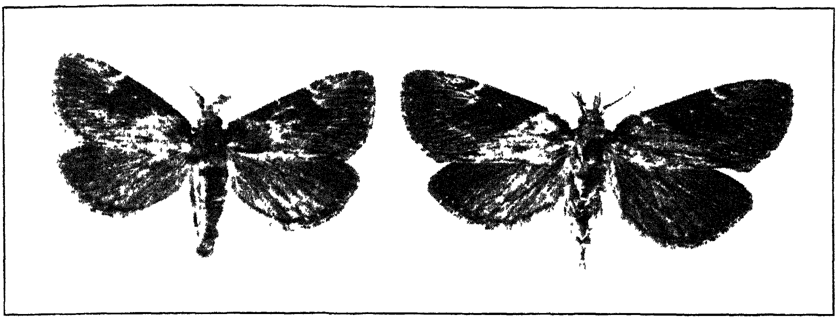
The writer and his assistants hunted for the eggs, but could not find them. Presumably they are laid on the leaves of the food plant. The writer's hedge was slightly attacked in both 1910 and 1911. In one instance a tall hedge of *B. vulgaris* near the writer's home was almost entirely stripped of leaves at the top for a distance of two or three rods, leaving only the old webs containing the excrement, and rendering the hedge very unsightly. Spraying with lead arsenate would, of course, be the remedy.

The larva spins a web in which is collected the excrement, giving to the web a brown or dark gray color. This forms a case in which the larva lives and feeds. It is usually about two inches long and from three-eighths to one-half inch in thickness, though varying greatly in size and sometimes being several inches long. The case is attached to the leaves or twigs of the barberry and often includes both, as well as the fruit. As the eggs are laid about July 1st, it is usually a month later before larvæ or nests are noticed, and often two months later before they are conspicuous. After the leaves drop the old nests or webs disfigure the plants throughout the winter unless removed. The larvæ do not pupate in the nests, but go into the ground and transform in a tough cell, oval or oblong in shape and made of particles of soil held together by silk threads.

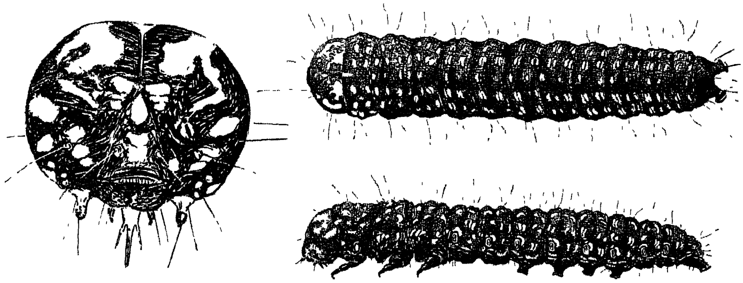
Identity and Literature

On account of the appearance and characteristic position of this moth when at rest with wings folded, as well as the antennal tufts of the male, it was thought to be a Deltoid, and specimens were sent for identification to Prof. J. B. Smith, who kindly replied as follows:

"Yours of the 5th inst. came duly to hand, and so did the box of specimens. The latter proved to be not Deltoids or Noctuids at all! —they belong to one of the Pyralid families, and the species is *Omphalocera dentosa.* I am under the impression that this species was



a



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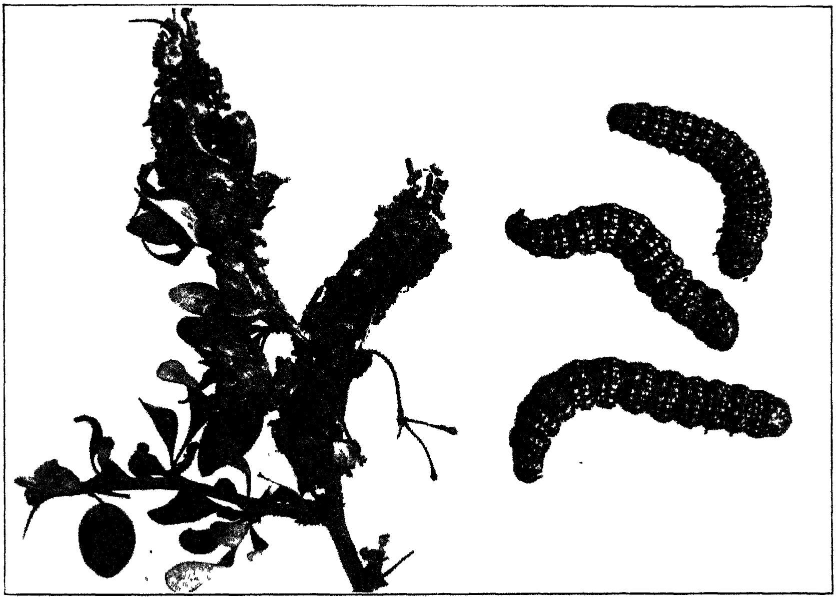


c

Omphalocera dentosa: *a.* Adults nearly twice enlarged; male at left. *b.* Larva, dorsal and lateral views, about twice enlarged. Front view of head at left, greatly enlarged. *c.* Nest at left, natural size. Larvæ at right, twice enlarged.

described and figured in one of the Government publications, but have no note on the subject, and can't be sure at the present time. I know that nothing much has been written concerning the species."

In searching the more accessible works for the literature of the species, only two references could be found. One of these was the original description which is included in this article, and the other a brief note by Dr. H. G. Dyar in an article entitled,—"A Review of the North American Pyralinæ" (Proceedings Entomological Society of Washington, Vol. X, p. 101, 1908), giving records as follows:

Omphalocera dentosa Grote.

"New Haven, Conn. (A. H. Verrill); Plummer's Island, Maryland, June 6, 1902 (H. S. Barber); Ames, Iowa, June 6, 1896 (C. P. Gillette); Black Jack Springs, Texas (Wm. Barnes); Dallas, Texas, May 31, 1896 (Dept. Agr. No. 6351), larvæ on *Berberis*. I have also a female from Durango, Colorado, that is less vinous in tone and more darkly colored, perhaps a distinct species, but with the present material I do not venture to separate it."

"Larvæ received from Mr. A. H. Verrill, which I think belong to this species, are black with many white dots, without the red lines of *cariosa*."

Dr. H. T. Fernald has also kindly examined the card index in his office and consulted his father's catalogue, and assures me that no other references occur there.

As the literature seems to be scanty, this brief article is submitted for publication in the hope that it may be of help to other workers who may collect or observe the caterpillars on barberry.

Description

Adult. The species was described from a female specimen by Grote, in Bull. U. S. Geological and Geographical Survey of the Territories Vol. VI, No. 2., p. 272, as follows:

Omphalocera dentosa, n. sp. *Female.* A little larger than *cariosa*, with quite a different color, being dusty olive brown, without any reddish brown tinges. The median space is dark blackish brown. The pattern of ornamentation is the same, but the outer line is composed of well-defined and rather broad, open teeth. The line is double, filled in by a pale shade, and is brought a little nearer the margin over the median nervules than in *cariosa*. The interspaces beyond the t. p. line show dentiform shadings of the lighter and darker colors of the wing. The fringes are dark. The terminal dots do not contrast as much as in *cariosa*. The veins are darker marked. *O. dentosa* has the under surface fuscous with a common external double line near the border, which seems a little less strongly dentate than in *cariosa*. The abdomen is furnished with brown tufts on the dorsum in both forms. In place of the discal mark (?) there is a pale dot on the subcostal vein and one below it on median vein, quite distinct in *cariosa*, hardly evident in *dentosa*, which expands 40 mil."

I have not been able to find any description of the male, and take it to be undescribed, but in the specimens reared it closely resembles

the female in color and markings. The median space is smaller and less well-defined, the markings are slightly less distinct, and it is smaller in size. Both sexes have the dark brown or black tufts on the dorsum of the abdomen, and the male has the brown antennal tufts and the longer anal tuft which are sexual characters.

The specimens reared are somewhat more of a reddish brown tint than one would expect from Grote's description, yet there is a distinct olive tint on the basal two thirds of the secondaries.

Larva. Length, about one and one-half inches, thickness about three sixteenths of an inch; somewhat flattened and thicker laterally than vertically. Ground color black dorsally, brown ventrally. Marked dorsally and laterally by small white irregular shaped spots arranged rather irregularly as follows: Two transverse rows on each segment as seen dorsally; three longitudinal rows as seen in lateral view, one nearly in line with the spiracles, one above and one below, these being in addition to the transverse dorsal rows of spots. Sometimes a fourth longitudinal row may be made out below the other three and at the base of the legs and pro-legs. Head dark brown or black, sculptured or pitted and shining; marked with white patches more or less irregular in shape, the arrangement not entirely symmetrical. Legs black and shining, with white patches on the first and second basal joints. Head and body sparsely covered with nearly straight light and dark hairs of medium length.

The larvæ, adults and nests are shown in Plate 20. Credit is due to my assistants, Messrs. B. H. Walden and A. B. Champlain, to the former for making the photographs and to the latter for the drawing of the larva. Also to Professors J. B. Smith and H. T. Fernald for the courtesies already mentioned.

INSECTS OF THE YEAR 1911 IN IOWA.

By R. L. Webster

The year 1911 in Iowa was characterized by an early spring and a long, dry summer. These weather conditions had much to do with the oscillations of insect life in the state during the year. The following notes deal with some of the more important insects on which observations were made this year in Iowa.

Lepidosaphes ulmi Linn. Not until this year did I realize what an important enemy to the apple tree was the oyster-shell scale. In the northern part of the state a large number of orchards are infested with this insect, many trees being very badly injured and some even killed by the scale. In March of this year I made a 40 mile auto trip in Worth county, in the northernmost tier of counties in the state, and found that scarcely an orchard in the county was not infested. Most of them were seriously injured. From observations made elsewhere

in northern Iowa it seems probable that other counties are equally as well infested with the oyster-shell scale as Worth county.

All of the samples of this scale which have been sent in to the Experiment station in recent years have come from the northern half of the state. The scale occurs in southern Iowa, but rarely, and when it is found, the infestation is light. I am not sure what is the cause for this difference, but think likely that it is on account of more favorable conditions for the development of certain natural enemies of the scale. This is probably especially true of certain mites, concerning which I shall have more to say at another time.

Monostegia ignota Norton. This strawberry slug, or at any rate the species which has gone under this name, was very common in strawberry patches about Ames early in the spring. In one instance strawberry plants in a small field were practically eaten down to the ground by these slugs.

According to F. W. Mally there are in Iowa two common species of strawberry slugs.[1] These are quite similar and are doubtless often taken for a single species. In making some notes on these strawberry slugs this spring Mally's observations were found to be essentially correct. The second species of strawberry slug, *Harpiphorus maculatus* Norton, is fairly common in Iowa, although the first named species has been causing the more damage. This is probably due to the fact that the former species appears earlier in the spring, when the strawberry plants are smaller and less resistant to insect injury.

Meliana albilinea Hübner. The wheat-head army-worm, which caused much damage to timothy in northern Iowa last year, was practically lost sight of this year. Early in June it looked as if much injury would be done, since the partly grown larvæ were very common in many places. The continued long period of dry weather, however, completely dried out the timothy plants and heads, as well as other grasses, and the larvæ were left without suitable food The drought checked the wheat-head army-worms as well as the timothy.

Epitrix cucumeris Harris. The potato flea-beetle was again abundant in Iowa this year. Around Ames much injury to the tubers was noticed, as well as to the foliage. The tunneling into the tubers was found to be essentially as described by F. C. Stewart as occurring in New York State.[2]

Eriocampoides limacina Retzius. The pear-slug was less abundant at several places in the state where it has been common for several years. This decrease in numbers seems to have been due, for the most

[1] Insect Life, vol. ii, p. 137.
[2] N. Y. Agr. Exp. Sta. Bul. 113.

part, to the abundance of one of its egg parasites, *Pentarthron minutum*, Riley.

Carpocapsa pomonella Linn. The destructive spring freeze of last year, which played havoc with fruit in the state, had its effect on the codling moth as well as on the fruit. Where there were any apples at all last year, the codling moth was fairly common this year. But where all the fruit was lost, the insect was very rare indeed.

About Ames, where there were a few apples last year, the codling moth infestation was about normal, possibly slightly less than normal. Two varieties of apples, Wealthy and Ralls, came through with a fair crop last year, but practically everything else was killed by the frost.

In July I made a short trip in southwestern Iowa, where the fruit industry is of some little importance. About Glenwood, in Mills county, scarcely a sign of a wormy apple was found. I found one wormy apple in a day's time spent in orchards about this place. A very few second brood eggs were seen at this time, but not many. Practically all the orchards in this county were unsprayed, which fact makes the absence of the codling moth all the more notable. Most of the orchards had never seen a spraying outfit.

South from Glenwood, about Hamburg, close to the Missouri line, there was more codling moth injury in the orchards. Here, again, there were some apples the year before, so the larvæ were not completely starved out, as at Glenwood. The infestation around Hamburg was light, however, and since much spraying is done there, the insect was well kept in check.

Canarsia hammondi Riley. At Randolph, in southwestern Iowa, I ran into a severe infestation of the apple leaf skeletonizer in July. This insect is not an uncommon one in the state, although it rarely occurs in abundance. In this particular orchard at Randolph every tree was more or less injured. The damage was mostly in the top of the trees, and always on the young growth. At the tops of the trees the young branches were eaten back from one to two feet, so that the upper parts of the trees were bare and brown. These trees were sprayed with arsenate of lead for the codling moth after the blossoms had fallen, but not again that season. Since the skeletonizers kept to the younger growth they avoided the poison to a great extent. A considerable amount of the arsenate of lead was found still adhering to the leaves late in July, the scant rainfall of the season being insufficient to wash it all off.

Grasshoppers. Three species of grasshoppers were abundant in Iowa this year, *Melanoplus bivittatus* Say, *Melanoplus femur-rubrum* DeG., and *Melanoplus differentialis* Thos. Much damage was done to corn and also to small grain. Even apple trees in the vicinity of

infested pastures or meadows were defoliated. The weather conditions in this case had much to do with the damage done by the grasshoppers. The dry weather had kept the pastures bare for a long period during the summer, so that the grasshoppers were forced to find their food elsewhere, consequently the damage to grain crops.

In August a number of newspaper reports were noticed which gave accounts of flights of the grasshoppers. These were mostly from northern Iowa

Blister beetles. Two species of blister beetles, *Epicauta vittata* Fab. and *Epicauta pennsylvanica* DeG., were common in Iowa this year. The former species was abundant on potatoes, the latter on alfalfa, potatoes and corn. One farmer near Spencer, Iowa, told me that the black blister beetle (*Epicauta pennsylvanica*) literally cleaned out a field of alfalfa for him.

Since the grasshoppers were very common in the state, there should be plenty of grasshopper eggs for the blister beetle larvæ this fall, and it is certainly safe to prophesy an abundance of these two species for next year.

Chætocnema elongatula Crotch. This tiny, black, flea beetle, kindly determined for me by Prof. H. F. Wickham, was found causing very serious damage to apple foliage in an orchard near Storm Lake, Iowa, in August. The injury to the foliage made itself known by a dried appearance around the outer margins of the leaves. This was caused by the removal of the upper epidermis, which allowed that part of the leaf to dry out. Whole trees were brown and ragged from the injury. Where the damage was worst many leaves were cut nearly into shreds. On some trees not a leaf had been left uninjured, so that the damage had been very severe and was very conspicuous.

At first I could not detect the cause of the injury, but finally found the beetles fairly common on the leaves. The worst of the damage had been done, apparently, when I examined the leaves, and the beetles were no doubt decreasing in numbers. The owner of this orchard told me that he noticed the injury in June or July, while I did not visit the place until August.

The orchard was an old one, and in sod. Possibly the larvæ of this beetle may have been breeding in the sod, and suddenly becoming numerous, caused the damage to the foliage. I am not aware that this species has ever been recorded as being of any economic importance.

METHODS OF DETERMINING THE TOXICITY OF HYDROCYANIC ACID GAS

By George A. Coleman

Recent investigations point to the conclusion that a large percentage of the killing value of the hydrocyanic acid gas generated in practical fumigation work is lost through leakage of tents.

In order to determine the toxic value of the different percentages of hydrocyanic acid gas an extensive series of experiments with known percentages of the gas was planned, including the study of large numbers of various species of scale insects in various stages of development from the egg to the adult, as well as other insects. This is now being carried on in the insecticide laboratory of the University of California by the author and a number of assistants under the direction of Professor Woodworth.

Since no such extensive work has been previously done along this line, it has been necessary to develop new methods of experimentation and apparatus. These have proven so satisfactory for the purpose that a description of the apparatus and methods of handling the scale insects may be of interest to other workers in this field of investigation.

The average dosage used in practical fumigation work rarely produces above 0.36 per cent HCN which Professor Woodworth estimates has an average efficiency of not to exceed 0.09 per cent HCN. Our work, therefore, is with percentages of gas from 0 per cent to 0.36 per cent.

In our experiments we begin with a very low percentage and increase it at will to any strength desired. The method used enables us to begin with a production of 0.005 per cent HCN or less and increase the production each time by this amount.

After considerable experimenting with the different cyanides and acids, we find the use of purified potassium cyanide (98–99 per cent or c. p.) and c. p. sulphuric acid (sp. gr. 1.84) gives the best results. For the gas generating vessel we use an ordinary Woulff bottle with three necks, of about 1000 cc, capacity. In this bottle is first placed 500 cc. of distilled water to which is added 5 grams of cyanide, and the acid is added as the gas is required. Beginning with sufficient cyanide to produce 0.005 per cent HCN in the air as it passes through the liquid solution, it is only necessary to add 0.1 cc. of concentrated H_2SO_4 in order to produce this percentage. As it is rather difficult to measure out so small a quantity of acid we use a 10 per cent solution and add 1 cc. instead of 0.1 cc.

For control of the gas production the following table, constructed from the results of a large number of experiments, can be depended upon to give very satisfactory results in production of the low percentages of gas required in the work.

1 Litre of Hydrogen=0.0896 gram

1 Litre of HCN=.0896×9.006 (At. wt. HCN)=.8060 gram

1 cc. $AgNO_3$ N/10=.00054 gram HCN. 1 cc. $AgNO_3$ N/100=.000054 gram HCN

5	grams KCN (98–99%) in 500 cc. H_2O (distilled) at 15° C.			
+5	cc. H_2SO_4 c. p. (10%)	= .75 cc. $AgNO_3$ N/100	= 000040345 gram HCN	= .005%
+1	" " " "	= 1.5 " " "	= .00008069 " "	= 01 %
+1	" " " "	= 2.25 " " "	= .000121035 " "	= .015%
+1	" " " "	= 3. " " "	= .00016138 " "	= .02 %
+1.5	" " " "	= 3.75 " " "	= 000201725 " "	= .025%
+2	" " " "	= 4.5 " " "	= .00024207 " "	= .03 %
+2	" " " "	= 5.25 " " "	= 000282415 " "	= .035%
+2	" " " "	= 7 5 " " "	= .0040345 " "	= .05 %
+2 5	grams KCN			
+3	cc. H_2SO_4 c. p. (10%)	=11 2 " " "	= .00605175 " "	= .075%
+5	" " " "	=14.9 " " "	= .008069 " "	= .1 %
+5	" " " "	=22.4 " " "	= .0121035 " "	= .15 %
+2.5	grams KCN			
+3	cc. H_2SO_4 c. p. (10%)	=29 8 " " "	= .016138 " "	= .2 %
+5	" " " "	=39.2 " " "	= .0201725 " "	= .25 %
+2.5	grams KCN			
+3	cc. H_2SO_4 (10%)	=44.8 " " "	= .024207 " "	= .3 %
+5	" " "	=52.3 " " "	= .0282415 " "	= .35 %

The amount of gas produced by the addition of the given quantity of acid will vary slightly at different temperatures. The quantities noted being for an average of 15°C. It will require slightly less at higher temperature and more at lower temperatures.

A centigrade thermometer is inserted through one hole in the cork in one neck of the Woulff bottle into the liquid and a record made of the temperatures throughout each experiment.

For measuring the acid a 25 cc. pipette graduated to 0.1 cc. and fitted with rubber tube and pinch cock for controlling the flow, mounted in a holder, is very satisfactory.

In order to eliminate all chance of leakage, or contamination of gas, a Novy's gas-jar (Plate 21) is used for treating large numbers of scale insects at one time. While for treating scale or other insects in series, a series of vials, each five inches in length, with two hole rubber corks through which glass tubing is passed, one tube reaching well down to the bottom of vial, the other just through the cork and the vials are connected in series as desired by rubber tubing (Plate 22).

One end of this series of vials is connected with the gas-generating bottle by rubber tubing. A calcium chloride tube being inserted if it is desired to use dry gas. The other end of the series is connected with a gas wash bottle of 250 cc. capacity in which is placed 200 cc. of N/100 solution of potassium hydrate (KOH). This flask is connected

with an aspirator of one litre capacity and it in turn connected with a vacuum filter pump fitted to the water faucet.

In order to get the full value of the air bubbles as gas conveyors a "Cottrell spiral" of very fine platinum wire is inserted in the end of a glass tube drawn down to a fine point and this tube runs through the cork in one neck of the Woulff bottle and a similar one placed in the KOH flask and the air in passing through them is thus broken up into tiny bubbles.

When a jar or a series of vials containing the scale or other insects is ready for treatment, all connections are made gas tight, the proper amount of acid added to the cyanide solution and the vacuum pump started. As soon as sufficient vacuum is created in the fumigating jar or vials, a stream of air comes bubbling through the cyanide solution, conveying the gas into the jar or vials, and through them into the KOH solution where it is collected for titrating.

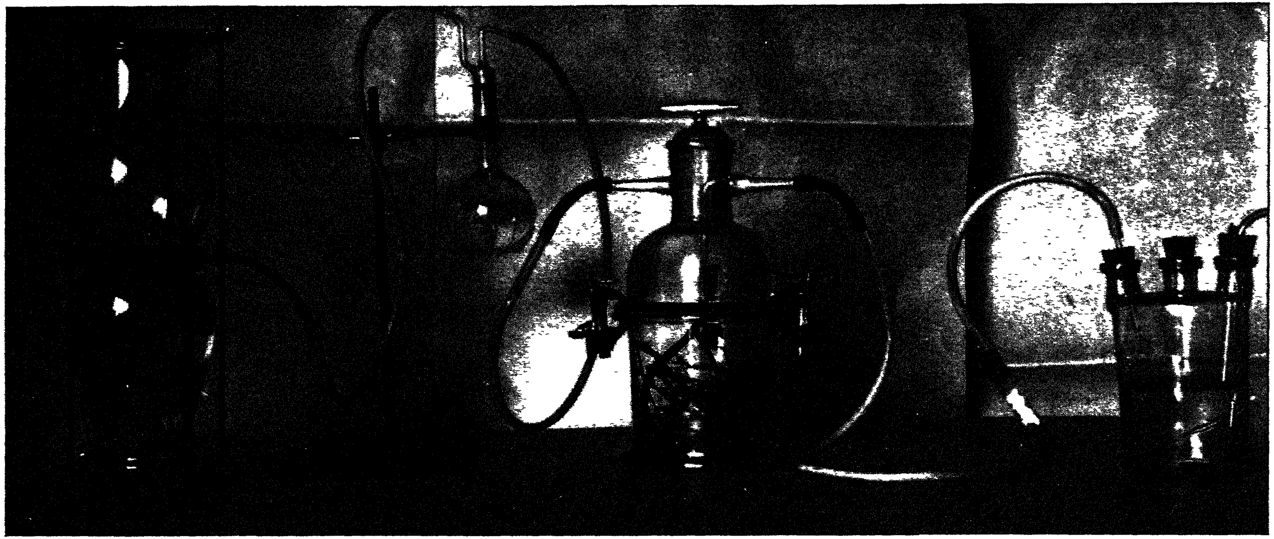
In order to allow of a thorough diffusion of the gas in the jar or vials, the pump is kept running for about fifteen minutes or 15 litres of gas run through. A fresh solution of KOH is then placed in the flask and two litres of gas, as measured by the aspirator, is run through and collected in the flask for titration.

The KOH solution is now titrated with silver nitrate ($AgNo_3$) solution using a N/100 solution instead of N/10 as the reaction with the weaker solution is more delicate and more easily controlled.

For measuring the titrate solution we use a 100 cc. Mohr's burette graduated to 0.1 cc.

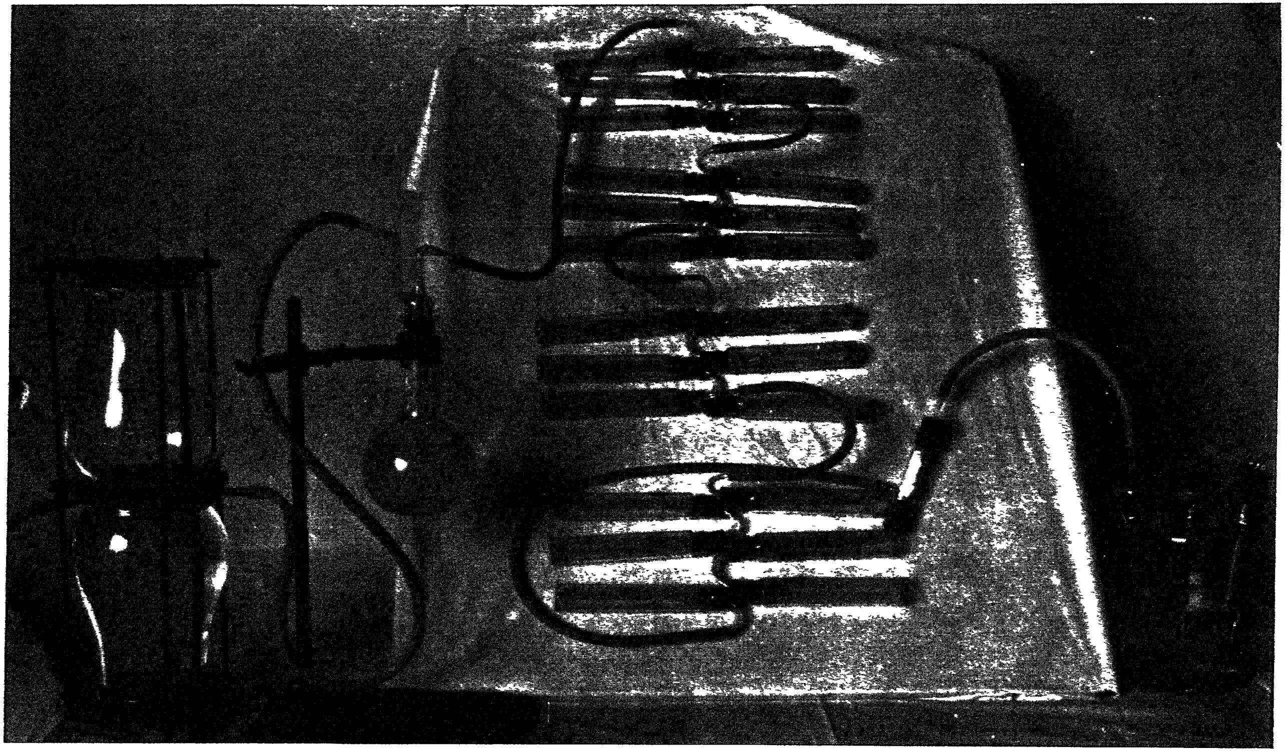
For containing the insects we use the O size gelatine capsules, placing one or more insects in each capsule and one or two capsules in each vial. In fumigation the caps are removed from the capsules and afterward replaced. A series of living insects placed in capsules and subjected to the same conditions as to temperature, moisture, etc., but leaving out the cyanide treatment is kept as checks for each series of treated insects.

For keeping a record of each experiment a card, designed by Professor Woodworth, is used. This card contains appropriate headings for recording the locality, date, temperature, time, weight of cyanide, etc., and numbered spaces for thirty insects. When running series, we use one card for each percentage of gas, dividing the spaces into four lots, allowing one space for recording the living check and six spaces for recording the treated insects in each lot. The squares containing the numbers for treated insects are colored yellow with India ink while those for the checks are left white. This arrangement being of considerable assistance to the eye in recording quickly and accurately.



Illustrating Apparatus Used in Fumigation Experiments

Beginning at the right.—Woulff bottle used for generating the HCN, Calcium Chloride tube for drying the gas, Novy's gas jar, gas wash bottle containing the KOH solution for collecting the HCN, one litre aspirator for measuring the amount of gas collected. (Original.)



ILLUSTRATING APPARATUS USED IN FUMIGATION EXPERIMENTS
Set of vials used in running through series of coccidæ. (Designed by Professor Woodworth.)

The four lots are designated by letters of the alphabet and in each capsule containing an insect is placed a small label bearing, in pencil, the letter and serial number designating the exact place in the series of that particular insect. The four lots run through under each percentage of gas are allowed to remain in the gas for periods of fifteen, thirty, forty-five and sixty minutes respectively, the time being recorded on the card opposite each lot. We thus have the entire record for each series, with checks, on one card. For each stage or condition of the insect treated we run through at least nine of these entire series, representing as many different percentages of gas, in one day.

These series of treated insects and living checks are placed in glass tumblers or in common white envelopes for future examination or storage. The series are examined from time to time and careful records made on the cards of the recovery of any treated insects or death of the checks, so that when complete the results may be tabulated direct from these card records.

In preparing the insects for treatment they are handled as little as possible. The scale insects being treated mostly *in situ* on the twig, simply cutting the twig into short pieces holding one or more insects and one piece placed in each capsule. We have also treated the eggs and young *en mass* by placing large numbers in each capsule, and usually, where material will permit, a large number are treated in the Novy's jar as a check for those treated in vials for each percentage and also to record the effect on parasites.

For some series we use the gas as it comes from the generator saturated with moisture while for others it is dried by passing through a calcium chloride tube. Other entire series are placed in the large refrigerator in the basement of the Entomological building during treatment in order to record the effect at different temperatures.

For these experiments we require thousands of specimens of the various species of Coccidæ found in California. Many of these have already been collected, or their collection arranged for by Professor Woodworth on a recent trip through the Santa Clara Valley and the southern California citrus district for this purpose.

While it is desirable to obtain as large an amount of data as possible before tabulating the results of our experiments, they have been sufficiently comprehensive to show that the percentage of hydrocyanic acid gas necessary for killing the eggs, larvæ and adults of most species of Coccidæ where there is no leakage is less than .025 per cent or about one sixteenth the dosage used at present in fumigation work.

CARBON DISULPHIDE EXPLOSION FROM HEATED CORN

By W. E. Hinds, *Entomologist, Alabama Experiment Station, Auburn, Ala.*

For many years carbon disulphide has been quite extensively used for the destruction of insect life in stored grain and similar materials. There has been some hesitation in recommending this for general use because of the explosive nature of mixtures of the vapor of this material with air. It has been customary to state in connection with directions for treatment with this material, an explicit caution against allowing any form of fire to occur or be brought near the liquid carbon disulphide or the room in which it was being evaporated. The customary warning has been against lighted cigars, artificial lights of all kinds even including the turning on and off of electric lights and fans and also against exposing the liquid in rooms heated by steam while the steam was on.

So far as the writer has known personally, the accidents connected with the use of carbon disulphide have been very few indeed. In fact, the only explosion of which I have ever heard directly was started by the blow of a hammer upon a nail head in nailing up a box in which specimens had just been heavily treated with carbon disulphide. The explosion resulting in this case is stated to have landed the workman on top of some exhibition cases in the U. S. National Museum. No record of an explosion in connection with the treatment of storehouses or stored grain or other products has ever come to me personally until the present instance which I believe should be reported for the general information of those who may have occasion to recommend the use of this material.

In the southern part of Alabama especially, the "black weevil" or "rice weevil" is a most serious enemy to corn and many times accomplishes practically the complete destruction of corn even before Christmas. To protect corn from this and other insect pests we have recommended freely and used quite extensively carbon disulphide for fumigation. This treatment has given fairly good satisfaction where used in doses of from 15 to 20 lbs, per thousand cubic feet in tight cribs or buildings. Probably the most successful case of weevil control occurred on the very spot where the explosion which we are now reporting took place. Certainly it was the most successful that we have ever observed.

The owner of a large plantation near Montgomery, Ala., constructed a few years ago several solid concrete rooms for the storage of corn. The floor and the walls to a height of ten feet, are of solid concrete. A flooring occurs at the eaves line and the space under the roof is used

for the storage of hay. All partitions were made of matched flooring. Several strong rooms were thus constructed capable of holding several thousand bushels of corn. This place, therefore, offered ideal conditions for the control of corn infesting insects by carbon disulphide fumigation and treatment here during the two years preceding had given very satisfactory results.

Throughout the South there is a common custom of storing corn with the shucks on. Most farmers believe that this protects the ear from insect attack to some extent although we doubt whether this is really the case. It is a common idea that the best method of handling corn is to allow it to stand in the field until after one or two hard frosts have occurred, then to break the ear from the stalk during a rainy spell or while the shuck is real wet and store this wet corn immediately. Many farmers know that in large masses such wet corn is likely to heat and they seem to understand that the heating, occasionally at least, is quite effective in destroying insect life in the heated corn. So far as we have been able to learn very many of those who have followed both of these ideas have still lost their corn where any considerable quantity was carried in storage until May or June of the following year. It seems that a certain combination of conditions must exist to produce a degree of heat which will be sufficient to destroy insect life and that these conditions are not sufficiently understood so that the desired results can be attained with any degree of regularity and certainty.

In the case which we are considering a large force of workmen was put to harvesting the corn during a rainy period which made it impossible for them to continue their regular work of picking and ginning cotton. Thus in a single day, fully 1,200 bushels of corn in the shuck which was unusually wet were placed in one mass in this concrete building in a room containing about 2,400 cubic feet. One week after this corn was stored the carbon disulphide treatment was applied as the weevils were found to be very numerous in the corn at that time. The mass of corn was known to be hot but the owner had no suspicion that this heat was sufficient to be an element of danger in connection with the carbon disulphide treatment. The liquid was passed into the room and distributed over the corn by two negroes, the room being so full of corn that they had barely space to work around between the floor above and the top of the corn. Naturally the heat of the mass evaporated the carbon disulphide with unusual rapidity and when 30 lbs. of the liquid had been distributed, the vapor became so dense that the workmen were forced to retire. The door opening to the outside was immediately locked and the owner with one helper started pasting paper over the cracks around the door, which is about 3 x 3½ feet and

set about half way up the concrete wall. Within a minute after the pasting of the paper began, a "pop" was heard within the treated room and immediately this was followed by a low, rumbling explosion which blew the door off entirely and threw the workmen to a distance of about thirty feet. These men were unconscious for several minutes but not seriously hurt. The two in front of the door were protected from the flame by the door while another man standing beside the door was quite badly burned in the face, the flames being deflected toward him by the falling door. Fire immediately followed the explosion and in spite of the convenient presence of an abundant supply of water and a large force of men, it was found very difficult to extinguish the fire. The corn shucks were burned more or less to a depth of two or three feet in the mass. The gas still continuing to rise was too dilute for explosion but still inflammable and was not easily quenched even with an abundant supply of water. Undoubtedly the concrete wall together with the corrugated iron roof saved what must otherwise have been a complete loss of the building and contents.

As it is the explosion caused two slight cracks in the concrete wall a foot or more thick. The floor over the corn and the entire roof of the building was lifted probably at least a foot in height and then fell back to approximately its original position. Wooden partition walls were blown out in all directions. Heavy 4 x 4 studding was split and misplaced. It is evident that the explosion occurred throughout the mass of corn as corn was hurled in all directions. An interesting evidence of this may be seen where a 2 x 10 inch floor timber was split lengthwise about in the middle, the upper part being lifted with the floor above and a space thus occurred between it and the lower part which was lifted less. Between these two parts of this floor timber, five or six ears of corn were found wedged tightly after the explosion. They had evidently been caught in the act of passing through this space as the timbers settled together.

The injury to the grain was not great although the shucks were burned more or less on several hundred bushels of corn. Even on ears where the fire destroyed all of the shuck on one side, live, active weevils occurred and were evidently unaffected on the other side of the ear. The damage to the building is comparatively small on account of its type of construction but may prove to be greater than now appears.

Naturally an accident of this kind calls for the fullest investigation and this was given by the writer about two weeks after the explosion occurred.

After fully examining the premises, talking with those who had applied the treatment and studying the conditions existing at that

time, it seems absolutely impossible that the explosion should have started in this case from any fire source whatever. It is known that the vapor of carbon disulphide becomes explosive at a temperature of between 295 and 300° F. even without preceding flame. In this case it seems certain that the large mass of wet corn in the concrete building from which moisture could escape only upward, was at the time of treatment undergoing a heating which produced a temperature of at least 300° F. in some part of the mass. This high temperature started the explosion as soon as the vapor of the liquid poured on top of the corn had penetrated to a point where such heat occurred. This is probably the only case of its kind that has ever occurred. At the time of the examination, three weeks after the storage of the corn, all heat had disappeared from the mass and unquestionably treatment could have been repeated with entire safety as indeed the owner proposes to do.

As indicative of the high temperatures which may be produced under very similar conditions I might mention the heat known to occur where large masses of seed cotton was stored awaiting ginning. On the same plantation but a short time before this explosion, it was found in handling a large mass of such stored cotton that the hands of the workmen could not endure the temperature of the mass. Burlap sacking used to protect the hands was so charred and weakened by the high temperature that it quickly fell to pieces. Doubtless in this case also a temperature of over 300° F. occurred.

These cases are thus fully reported because it seems to the writer advisable henceforth to add one other precaution to those which are usually stated in connection with the recommendations for the use of carbon disulphide, that is that treatment with carbon disulphide should never be attempted where there is any evidence of high temperature occurring anywhere in the mass of grain or other material to be treated. Doubtless treatment might be given immediately upon storage before such heat developed or after a delay of two or three weeks' storage, which would allow the heat to pass off so that danger from it would also have passed.

PRELIMINARY REPORT OF THE COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

By E. D. Sanderson, *Chairman*

As instructed at the last meeting of the American Association of Economic Entomologists, the committee on entomological investigations prepared the following letter which was sent to the heads of all departments conducting entomological investigations in this country:

Dear Sir:

At its last meeting the American Association of Economic Entomologists appointed a standing committee on Entomological Investigations. The object of this committee is outlined in the February number of the Journal of Economic Entomology, page 4, paragraph 2; pages 19 and 20, and in the report of Dr. T. J. Headlee on page 35, which please refer to.

It is the object of this committee to gather together data concerning the entomological investigations now in progress by members of the association and those contemplated during the coming year. It is proposed to publish a tabular statement of these projects in the December number of the Journal of Economic Entomology, so that those interested in similar projects can get together for conference at the next meeting if they so desire.

The committee trusts that it may have the very general coöperation of all members of the association in making this statement full and complete. At the next meeting of the association the committee will make a report embracing a general discussion of the investigation work being carried on. It was felt by the association that an interchange of information concerning investigations in hand and proposed, could not help but encourage voluntary coöperation on the part of the members, so that it would lead to planning their work together so that results might be more readily comparable and so that workers in the same field might be of greater mutual assistance.

Please give the following information for each project you are now prosecuting:

1. Name.
2. Object.
3. Reasons for undertaking.
4. Scope.
5. Coöperation with other departments, bureaus, or agencies.
6. General difficulties you are experiencing.
7. General methods you are using.
8. What proportion of the time of one or more men is devoted to this project?
9. Progress.
10. Source of funds used for support of the project.

Please give similar information for each project which you propose to undertake during the year 1912.

The committee will be greatly indebted if you will furnish this information to its chairman so that we can have it in hand by October 15 as it will take some time to collect the information and doubtless some correspondence will be necessary before we can complete the report.

And greatly oblige,

Very truly yours,

E. D. Sanderson, *Chairman.*

The replies which have been received to date (November 5) are arranged below according to subjects. Some ten or twelve correspondents are still to be heard from and their replies will be prepared in similar form and published in the next issue.

In the following list the letter before the name of the project indicates the fund under which it is carried on, insofar as the funds were indicated by the correspondent; (A) is for Adams Fund, (H) for Hatch Fund, and (S) for State Funds. In many cases where the entomologist of the experiment station is also state entomologist, it was not possible to determine from the replies made whether the project was carried on under experiment station funds or state appropriations. In many cases the correspondent failed to give the names of assistants carrying on certain lines of work, in which cases the statement is made to that effect.

This preliminary report is published at this time so that it may furnish the basis for conferences between those workers who are prosecuting similar investigations at the Washington meeting of the Association. The committee expect to present their final report at that meeting.

Acarina

1. Cattle tick; a study of its biology.
C. F. Adams, Ark. Agr. Exp. Sta., Fayetteville, Ark.

2. (A) North American Fever Tick. Life history investigations and a study of the climatic factors affecting the fever tick with special reference to temperature. (Coöperation U. S. Bureau of Entomology and U. S. Weather Bureau.)
E. C. Cotton, Tenn. Agr. Exp. Sta., Knoxville, Tenn.

3. (S) Eriophyidæ of New York. A monographic study.
H. E. Hodgkiss, N. Y. Agr. Exp. Sta., Geneva, N. Y.

4. (A) Hog louse. Life history investigations as a basis for methods of control. Project for 1912–13.
E. C. Cotton, Tenn. Agr. Exp. Sta., Knoxville, Tenn.

Coleoptera

5. (S) Wireworms; life history and means of control.
W. P. Flint, Field Laboratory of Ill. State Entomologist, Springfield, Ill.

6. (S) White grubs; life history and means of control.
W. P. Flint, Field Laboratory of Ill. State Entomologist, Springfield, Ill.

7. (S) Fleabeetles affecting corn.
Assistant of S. A. Forbes, State Entomologist, Urbana, Ill.

8. (S) Rosechafer. Life history and means of control.
F. Z. Hartzell, N. Y. Agr. Exp. Sta., Geneva, N. Y.

9. (S) Grape root-worm; life history, habits, and means of control.
F. Z. Hartzell, N. Y. Agr. Exp. Sta., Geneva, N. Y.

10. (H & A) Round-headed apple-tree borer (*Saperda candida*); studies of life history and means of control.
Paul Hayhurst, Ark. Agr. Exp. Sta., Fayetteville, Ark.

11. Oak tree borer.
A. G. Ruggles, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

12. Elm tree-borer.

A. G. Ruggles, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

13. (S) *Polydrosus impressifrons*; life history and distribution of this newly imported species.

W. J. Schoene, N. Y. Agr. Exp. Sta., Geneva, N. Y.

14. (S) Fruit-tree bark-beetles (*Phleotribus liminaris* and *Scolytus rugulosus*). Observations and experiments in control.

Assistants of H. A. Gossard, Ohio Agr. Exp. Sta., Wooster, Ohio.

15. (A) Rice weevil (*Calandra oryza*); life history, economic relationship, injury and control.

W. E. Hinds and assistants, Ala. Agr. Exp. Sta., Auburn, Ala.

16. Corn bill-bug (*Sphenophorus venatus*).

C. S. Spooner, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

17. (A) *Sphenophorus callosus* and other injurious species of *Sphenophorus* in North Carolina. A complete biological study of the species injurious to corn in North Carolina and determination of methods of control.

R. I. Smith, N. C. Agr. Exp. Sta., West Raleigh, N. C.

18. (S) Plum curculio; study of life history and orchard tests of sprays. (In cooperation with Horticultural Dept. and fruit growers.)

T. J. Headlee, L. M. Peairs, and Rees Hillis, Kas. Agr. Exp. Sta., Manhattan, Kas.

19. Plum Curculio; life history study and methods of spraying.

A. G. Ruggles, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

20. Plum Curculio; life history studies and control measures.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Canada.

Diptera

21. (A) *Nematocera*. A study of the early stages of some Nematocerous diptera with special reference to economic species; ecology, morphology, and taxonomy.

O. A. Johannsen, Me. Agr. Exp. Sta., Orono, Me.

22. (H) Control of black-flies, deer-flies, and midges. Experiments in the control of these and similar pests in the mountainous resort region of New Hampshire with incidental life history studies.

W. C. O'Kane, N. H. Agr. Exp. Sta., Durham, N. H.

23. The sand fly and pellagra; to determine what part, if any, the sand fly has in the transmission of this disease. (Coöperation with State Board of Health.)

S. J. Hunter, and W. T. Emery, Univ. of Kas., Lawrence, Kas.

24. (S) Grape midge; life history, habits and means of control.

F. Z. Hartzell, N. Y. Agr. Exp. Sta., Geneva, N. Y.

25. (S) Gall midges; a monographic study of biology and taxonomy.

E. P. Felt, State Entomologist, Albany, N. Y.

26. (S) Hessian fly; field observations on abundance and measures of control.

H. A. Gossard and assistants, Ohio Agr. Exp. Sta., Wooster, Ohio.

27. (S) Hessian fly; life history, habits and means of control. (In coöperation with U. S. Bureau of Entomology.)

P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.

28. (S) Narcissus fly (*Melodron equestris*); life history and control measures.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

29. (S) House-flies; a study of parasites, range of flight and general economic relations.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

30. (S) Root maggots; experiments in methods of control.
C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.
31. (S) Cabbage maggot; studies of life history, habits, methods of control, physiological reactions of puparia to heat and dessication, and methods of protecting seed beds.
W. J. Schoene, N. Y. Agr. Exp. Sta., Geneva, N. Y.
32. (S) Apple maggot; life history and control measures.
C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.
33. (A) Apple maggot (*Rhagoletis pomonella*). A thorough study of the life history, and measures of control.
W. C. O'Kane, N. H. Agr. Exp. Sta., Durham, N. H.

Hemiptera

34. (S) Green soldier-bug (*Nezara hilaris*); life history study and means of control in peach orchards.
Assistant of H. A. Gossard, Ohio Agr. Exp. Sta., Wooster, Ohio.
35. (S) False tarnished bug (*Lygus invitus* Say). The life history, habits, and methods of control of this pest of the pear.
H. E. Hodgkiss, N. Y. Agr. Exp. Sta., Geneva, N. Y.
36. (S) Chinch-bug; life history and means of control.
W. P. Flint, Springfield, Ill., and L. M. Smith, Carbondale, Ill.
Field laboratories of the Ill. State Entomologist.
37. (H) Chinch-bug investigations to discover practical means of control, based on careful life history studies.
T. J. Headlee, J. M. McColloch, and F. B. Milliken, Kas. Agr. Exp. Sta., Manhattan, Kas.
38. (S) Chinch-bug; field observations on abundance and measures of control.
H. A. Gossard and assistances, Ohio Agr. Exp. Sta., Wooster, Ohio.
39. (S) Grape leaf-hopper; life history, habits and means of control.
F. Z. Hartzell, N. Y. Agr. Exp. Sta., Geneva, N. Y.
40. Membracidæ; studies in development, morphology and embryology.
Hazel Branch, Univ. of Kas., Lawrence, Kas.
41. (A) *Psyllidæ.* Ecological studies and descriptions of *Psyllidæ* of New England.
Edith M. Patch, Me. Agr. Exp. Sta., Orono, Me.
42. (S) Pear psylla. To determine more efficient methods of control; attention is being given to the effects of the various elements of the environment on larval activities.
H. E. Hodgkiss and P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.
43. (A) *Aphididæ.* Ecological studies of the *Aphididæ* of Maine.
Edith M. Patch, Me. Agr. Exp. Sta., Orono, Me.
44. (A & H) *Aphididæ.* Investigations of the *Aphididæ* of Colorado; studies of life histories, food plants and means of control.
C. P. Gillette and assistants, Colo. Agr. Exp. Sta., Fort Collins, Colo.
45. (H) The cotton or melon aphis (*Aphis gossypii*); life history, habits and means of control.
Wilmon Newell and assistants, Tex. Agr. Exp. Sta., College Station, Tex.
46. (A) Melon aphis (*Aphis gossypii*) parasites. Studies of the parasites of the melon aphis, their relative importance, other hosts, and possibility of artificially increasing these parasites.
L. Bruner and M. H. Swenk, Nebr. Exp. Sta., Lincoln, Nebr.
47. (S) Corn root-aphis; life history, habits and means of control.
W. P. Flint, field laboratory of Ill. State Entomologist, Springfield, Ill.

48. (H) Green-bug (*Toxoptera graminum*). An investigation of field spraying for incipient outbreaks; supplemental to project number 100.

T. J. Headlee and F. B. Milliken, Kas. Agr. Exp. Sta., Manhattan, Kas.

49. (A) Woolly aphis. A general study with special reference to its relation to other forms of the same species native in Arkansas and to the immunity of Northern Spy trees.

Paul Hayhurst, Ark. Agr. Exp. Sta., Fayetteville, Ark.

50. (S) Woolly aphis.

L. M. Smith, field laboratory of Ill. State Entomologist, Carbondale, Ill.

51. Woolly aphis; experience in methods of control on nursery stock.

H. B. Hungerford, Univ. of Kas., Lawrence, Kas.

52. (S) Woolly aphis.

E. L. Worsham, State Entomologist, Atlanta, Ga.

53. Woolly aphis; experiments with different solutions for control.

T. B. Symons and O. G. Babcock, Md. Agr. Exp. Sta., College Park, Md.

54. (S) Woolly aphis; spraying nursery stock. (Coöperation State Nursery Inspector.)

H. A. Gossard, Ohio Agr. Exp. Sta., Wooster, Ohio.

55. (A) Citrus white-fly; a study of its biology and measures of control. Study is now being given to determine the causes of natural mortality.

J. R. Watson, Fla. Agr. Exp. Sta., Gainesville, Fla.

56. (H) Scale insects of Texas.

Wilmon Newell and assistants, Tex. Agr. Exp. Sta., College Station, Tex.

57. (S) Fruit scales; life history studies and means of control.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

58. San José scale; methods of control.

A. J. Spangler, University of Kansas, Lawrence, Kas.

59. (S) San José scale; methods of control with lime sulphur wash, miscible oils and other sprays.

T. B. Symons, E. N. Corey, O. G. Babcock, Md. State Hort. Dept., College Park, Md.

60. (S) Terrapin scale; same as project 59.

Hymenoptera

61. (S) Larch sawfly (*Lygæonematus erichsonii*) and its parasites. European and North American parasites are being studied and an attempt is being made to introduce the latter from New England.

C. Gordon Hewitt, Div. Entomology, Dept. Agr., Ottawa, Can.

62. Larch sawfly.

A. G. Ruggles, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

63. (S) Cherry sawfly leaf-miner (*Profenusa collaris* Mac G.); life history, habits, and methods of control of this new cherry pest.

P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.

64. *Bruchophagus funebris.*

Warren Williamson, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

65. Gall-forming insects of Kansas with special reference to *Cynipidæ.*

Roy Fraser, University of Kansas, Lawrence, Kansas.

66. (S) Wheat joint-worm; field observations on measures of control.

H. A. Gossard and assistants, Ohio Agr. Exp. Sta., Wooster, Ohio.

68. (A) *Opiinæ.* A monographic revision of this family of *Braconidæ* with special reference to its economic importance.

A. B. Gahan, Md. Agr. Exp. Sta., College Park, Md.

69. (A) Parasites. A study of native hymenopterous and dipterous parasites of certain Maine insects, with experiments in rearing and propagation.

O. A. Johannsen and Edith M. Patch, Me. Agr. Exp. Sta., Orono, Me.

70. (H & S) Ant control, especially *Pogonomyrmex barbata* and species of *Solenopsis;* tests of insecticides and repellents.

A. W. Morrill, Ariz. Agr. Exp. Sta., Phoenix, Ariz.

71. *Larridæ.* A study of the biology and taxonomy of Kansas *Larridæ.*

F. X. Williams, University of Kansas, Lawrence, Kas.

Lepidoptera

72. (A) Pine-tip moth (*Retinia frustrana*); life history and means of control.

L. Bruner and M. H. Swenk, Nebr. Agr. Exp. Sta., Lincoln, Nebr.

73. (S) Spruce budworm (*Tortrix fumiferana*) and its parasitic means of control in Quebec, Eastern Canada and British Columbia.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

74. Garden webworm; a study of distribution and control in Maryland, especially on alfalfa.

O. G. Babcock, Md. State Hort. Dept., College Park, Md.

75. (H) A study of the waxworm; life history, habits and methods of control.

Wilmon Newell and assistants, Tex. Agr. Exp. Sta., College Station, Tex.

76. (S) Ermine moths of apple and cherry. A study of life histories, habits, and distribution in New York of these imported insects.

P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.

77. (S) Codling moth; studies of life history and means of control under the diverse conditions found in various parts of Arizona.

A. W. Morrill, Ariz. Hort. Comm. and Agr. Exp. Sta., Phoenix, Ariz.

78. (H) Codling moth; investigations of life history and means of control.

G. P. Weldon, Colo. Agr. Exp. Sta., Fort Collins, Colo.

79. (S) Codling moth; a study of spray efficiency.

E. P. Felt, State Entomologist, Albany, N. Y.

80. (S) Codling moth. A study of life history and orchard tests of sprays. (Coöperation of Department of Horticulture and fruit growers.)

T. J. Headlee, L. M. Peairs, and Rees Hillis, Kas. Agr. Exp. Sta., Manhattan, Kas.

81. (S) Codling moth; life history and means of control.

E. L. Worsham, State Entomologist, Atlantic, Ga.

82. (A) Peach tree borer. A study of the life history so as to secure exact information as to its relation to environmental conditions in Tennessee as a basis for developing a rational method of control.

E. C. Cotton, Tenn. Agr. Exp. Sta., Knoxville, Tenn.

83. (H & A) Peach tree borer; studies of life history and means of control.

Paul Hayhurst, Ark. Agr. Exp. Sta., Fayetteville, Ark.

84. (H) Peach tree borer; life history, habits, and methods of control.

Wilmon Newell and assistants, Tex. Agr. Exp. Sta., College Station, Tex.

85. Peach tree borer; life history and means of control.

T. B. Symons and E. N. Corey, Md. State Hort. Dept., College Park, Md.

86. Peach tree borer; life history studies and means of control.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

87. Cutworms; life history studies and means of control.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

88. Corn budworm (? *Heliothis obsoleta* Fab.); experiments in control.

Franklin Sherman, Jr., State Entomologist, Raleigh, N. C.

89. Corn earworm (*Heliothis obsoleta* Fab.). A study of the life history and methods of control on corn and garden truck.

T. J. Headlee, J. W. McColloch, Kas. Agr. Exp. Sta., Manhattan, Kas.

90. Browntail moth. A study of parasites and influence of local and other conditions.

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

Orthoptera

91. (H) Walking sticks (*Diapheromera femorata*); experiments in control.

W. E. Rumsey, W. Va. Agr. Exp. Sta., Morgantown, W. Va.

92. (H & S) Grasshopper investigations; studies of life histories of Colorado species, food plants, and remedial measures.

S. A. Johnson, Colo. Agr. Exp. Sta., Fort Collins, Colo.

93. (S) Grasshopper control; studies of poisoning, cultivation, mechanical contrivances, and artificial spread of fungous diseases.

L. Bruner, Nebr. Agr. Exp. Sta., Lincoln, Nebr.

94. Grasshopper control.

F. L. Washburn, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

95. (S) Mole cricket (*Scapteriscus didactylus*). (In coöperation with Ga. Agr. Exp. Station.)

E. L. Worsham, State Entomologist, Atlanta, Ga.

96. (S) Tree crickets. A study of the life histories, habits, and methods of control of *O. niveus* and related species.

P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.

Thysanoptera

97. (S) Thrips in cereals. The species around Ottawa are being studied as various species are present throughout Canada

C. Gordon Hewitt, Div. Entomology, Can. Dept. Agr., Ottawa, Can.

98. (S) Pear thrips (*Euthrips pyri* Daniel); life history, habits, distribution in New York and methods of control.

P. J. Parrott, N. Y. Agr. Exp. Sta., Geneva, N. Y.

99. (H & S) Orange thrips. Investigation of injury, seasonal history and method of control in Salt River Valley.

A. W. Morrill, Ariz. Hort. Comm. and Agr. Exp. Sta., Phoenix, Ariz.

General Subjects

100. (A & S) Investigations to determine the bearing of climatic factors upon the life economy of the Hessian fly and plant lice injurious to wheat and corn, including determination of maximum, optimum, and minimum conditions of temperature, moisture, sunlight, food supply, etc.

T. J. Headlee and student assistants, Kas. Agr. Exp. Sta., Manhattan, Kas.

101. A study of the influence of temperature and moisture on insect development.

Ruby Hosford, University of Kansas, Lawrence, Kas.

102. (S) Breeding investigation. An investigation to extend the knowledge of the laws of hybridization and to discover how to disturb the mechanism of transmission of characters so that new species may be produced. *Tettiginæ* used for material.

R. K. Nabours and student assistants, Kas. Agr. Exp. Sta., Manhattan, Kas.

103. (A) A study of inheritance of the honey-bee.

Wilmon Newell, Harper Dean and F. B. Paddock, Tex. Agr. Exp. Sta., College Station, Tex.

104. (S) Shade and forest tree insect investigations; with special attention to the elm leaf-beetle.

E. P. Felt, State Entomologist, Albany, N. Y.

105. (S) Park and truck garden insect investigations,

D. K. McMillan, Field laboratory of Ill. State Entomologist, Chicago, Ill.

106. (S) Insect Pests of alfalfa. Data is being gathered for a monographic treatment of this subject, which includes general collecting and life history studies.

L. Bruner, M. H. Swenk and assistants, Lincoln, Nebr.

Incidental to Insect Control

107. (A) The use of carbon disulphide and hydrocyanic acid gases as insecticide fumigants.

W. E. Hinds and assistants, Ala. Agr. Exp. Sta., Auburn, Ala.

108. (A) Control of root maggots. An investigation of the means of control of soil-inhabiting insects, including rate and extent of diffusion of gases and liquid insecticides in various types of soils, and their effect on animal and plant life.

W. C. O'Kane, N. H. Agr. Exp. Sta., Durham, N. H.

109. (A) A study of the physiological effect of lead arsenate on weevils of the order *Rhyncophora*.

Wilmon Newell, Harper Dean, and F. B. Paddock, Tex. Agr. Exp. Sta., College Station, Tex.

110. (S) Effect of dipping nursery stock in various insecticides to determine the influence on the trees and on the insects.

T. B. Symons and E. N. Corey, Md. State Hort. Dept., College Park, Md.

111. (S) Spraying apples to determine exact limitations of different insecticides in practical use on some 200 acres of orchards in various parts of Ohio; largely demonstrational. (In coöperation with horticultrual and botanical departments.)

H. A. Gossard and assistants, Ohio Agr. Exp. Sta., Wooster, Ohio.

112. (S) Spraying peaches, plums and cherries on 50 acres of orchards in various parts of Ohio to determine methods of control of insects and diseases in practical orchard operations; largely demonstrational. (In coöperation with horticultural and botanical departments.)

H. A. Gossard, and assistants, Ohio Agr. Exp. Sta., Wooster, Ohio.

113. Experiments to determine the effect of some commonly used sprays on the apple.

S. J. Hunter, A. T. Walker, and A. J. Spangler, University of Kansas, Lawrence, Kas.

114. (S) Lime-sulphur and other preparations with lead arsenate compared with Bordeaux mixture. (In coöperation with Botanical department.)

W. E. Britton, Conn. Agr. Exp. Sta., New Haven, Conn.

115. Effect of arsenical sprays on stock.

C. S. Spooner, Minn. Agr. Exp. Sta., St. Anthony Park, Minn.

116. (S) Study of spraying machinery.

Assistants of H. A. Gossard, Ohio Agr. Exp. Sta., Wooster, Ohio.

117. (S) Experiments in comparative efficiency of treatment of mills and granaries by heat and hydrocyanic acid gas, with life history studies of granary pests.

Assistants of H. A. Gossard, Ohio Agr. Exp. Sta., Wooster, Ohio.

118. (A) Stored grain and mill insect investigations, to discover practical methods of control, with life history studies.

Geo. A. Dean and student assistants, Kas. Agr. Esp. Sta., Manhattan, Kas.

VACATION NOTES IN THE ADIRONDACKS

By W. E. Britton, *New Haven, Conn.*

It was the writer's good fortune to spend two weeks of his vacation, July 8 to July 22, 1911, in the town of Jay, Essex County, N. Y., at an altitude of over 1,000 feet. The following entomological observations were made there, and most of the species herein mentioned were collected.

Acres of alders on the hillsides and along streams had been defoliated by the alder flea-beetle, *Haltica bimarginata* Say (=*alni* Harr.). In some cases the bushes were bare, but usually the network of the leaves still remained, and turning brown gave them the appearance of having been scorched by fire. The adult is one of the largest species of the genus *Haltica*, is dark blue and with a longitudinal fold on the outer margins of the wing covers.

Another and smaller flea-beetle, *Phyllodecta vittellinæ* Linn. (=*vulgatissima* Linn.) was feeding upon the terminal leaves of low-growing willows along the banks of the Ausable River.

The forest tent caterpillar, *Malacosoma disstria* Hubn., had evidently been quite abundant earlier in the season, as the separate empty cocoons were present on the trunk of nearly every tree, including pines, and on fences and stone walls. On the under side of large branches of apple trees one could see patches five or six inches in diameter of the cast skins or molts of the caterpillars. These trees also showed that considerable eating had been done by the caterpillars earlier in the season before the trees had ceased growing.

The underbrush in the pine woods, near the writer's cabin, was commonly infested by a soft scale, probably *Lecanium corni* Bouché. The brown empty shells were still clinging to the twigs, and the young were well established along the veins of the leaves as well as on the bark of the twigs. Many twigs and some small bushes had already been killed by this insect, which was noticed on elm, hazel, hop hornbeam or ironwood, sugar maple, yellow birch, paper birch, choke cherry, black cherry and bird or pigeon cherry.

Oyster shell scale was abundant, and one scrub apple in a pasture had been killed outright by it.

In climbing Mount Wainwright (one of the lesser peaks) I noticed a paper birch which had been attacked by the bronze birch borer, *Agrilus anxius* Gory, the spiral ridges caused by the tunneling of the larvæ showing prominently on the upper branches.

In the fields and pastures the grass was being destroyed by hordes

of grasshoppers, the most abundant species seemingly being *Camnula pellucida* Scudd.

Collecting in this region was especially poor because of the extreme drought, which was the most severe in the memory of the oldest residents. In the Lepidoptera, the Mourning Cloak, *Euvanessa antiopa* Linn. and the Compton Tortoise *Grapta j-album* Boisdv. & Lec., *Hadena arctica* Boisdv. and *Epizeuxis lubricalis* Geyer were very common in the pine woods around the cabins. The imported cabbage butterfly *Pontia* (*Pieris*) *rapæ* Linn. and *P. napi* Linn. were both rather abundant. *Polygonia faunus* Edw. and *P. progne* Cram. flitted about the cabin among the pine trees, and a few specimens were taken. The rarest capture, perhaps, was a perfect female specimen of *Plusia balluca* Geyer, which was brought to me one day by the landlady, who found it in the house. I afterwards found a fresh wing of the same species at the foot of a large pine, showing that tragedies occur in entomology.

Five specimens of *Caripeta angustiorata* Walk. and one of *C. divisata* Walk. were taken, and amongst the lot are several small geometrids, some of which have not yet been identified. Few noctuids were collected.

In the Diptera, which were mostly common species, there was a single example each of *Dasyllis posticata* Say and *Psilocephala rufiventris* Loew.

In the Coleoptera *Leptura canadensis* Oliv. was common flying about in the pine woods, and *Typocerus velutinus* Oliv. was abundant on flowers of *Spiræa salicifolia*. One example of *Cicindela longilabris* Say was captured. One specimen each of *Buprestis maculiventris* Say, *Corymbites æripennis* Kirby, and a female specimen of *Odontæus obesus* LeC., the latter originally described from California, were kindly identified for me by Mr. C. A. Frost.

A number of interesting insects in other orders were also collected, but many of these are still undetermined.

Elm Leaf Beetle (*Galerucella luteola* Mull.). This pest has been excessively abundant and destructive the past season on Long Island, throughout the Hudson valley and in other sections of the state where it has become established. The elms in many villages were so seriously affected that practically all the leaves were destroyed by midsummer. This serious injury also occurred on groups of elms or even roadside trees in the country. It is undoubtedly true that the damage was greatly accentuated by drought, yet it seems very probable that automobiles and trolley cars have been important factors in distributing an otherwise local though very prolific insect and, as a consequence, are indirectly responsible.

E. P. FELT.

NEW SPECIES OF GALL MIDGES

By E. P. Felt, *Albany, N. Y.*

(*Continued from page 484*)

Leptosyna quercus n. sp. *Male.* Length 9 mm. Antennæ extending to the third abdominal segment, rather thickly haired, pale yellowish; 13 segments, the fifth with a stem about three fourths the length of the subcylindric basal enlargement, which latter has a length one fourth greater than its diameter, is distinctly swollen subapically and bears a rather thick subapical band of long, stout setæ; twelfth segment subcylindric, slightly expanded and with a length nearly twice its diameter, the thirteenth slightly fused with the preceding, subcylindric, apically a short, stout knob. Palpi uniarticulate, the one segment with a length about two and one half times its diameter, tapering. Mesonotum shining reddish brown. Scutellum and postscutellum pale orange. Abdomen mostly pale whitish yellow, yellowish basally, the genitalia fuscous. The very narrow wings hyaline, with a thick fringe, the latter having a length about half the width of the wing; subcosta unites with costa near the basal half; the nearly straight third vein extends toward the apex of the wing, becoming obsolete at the distal fifth; the simple fifth vein joins the posterior margin near the basal half; each vein with sparse, long setæ. Halteres pale yellowish, reddish orange apically. Legs a nearly uniform pale straw, rather thickly haired. Anterior metatarsus with a length two and one-half times its diameter, the second segment twice the length of the first, the third about three fourths the length of the second, the fourth three fourths the length of the third and the fifth one half longer than the fourth. Claws slender, evenly curved, simple, the pulvilli about half the length of the claws. Genitalia; basal clasp segment long, stout, obliquely truncate; terminal clasp segment long, greatly swollen apically, a distinct spur; dorsal plate short, broadly and roundly emarginate, the lobes broadly rounded, chitinized, setose; ventral plate long, broad, broadly rounded.

Reared from decaying red oak bark taken at Nassau, N. Y. Type C. a2108.

Asphondylia eupatorii n. sp. *Male.*—Length 3 mm. Antennæ light brown; fourteen segments. Palpi; the first segment is irregular, with a length about twice its diameter, the second long, tapering distally and with a length fully five times its diameter. Mesonotum dark brown. Scutellum and postscutellum probably fuscous yellowish. Abdomen dark brown, thickly clothed with light hairs. Wings hyaline, costa dark brown. Halteres yellowish basally, fuscous apically. Legs; coxæ and the basal two thirds of femora yellowish, the distal portion of femora, tibiæ and tarsi dark brown, except the yellowish tibiæ, narrowly fuscous apically, of the posterior legs, while the first tarsal segments and the basal three fourths of the second are silvery white. Genitalia; basal clasp segment greatly swollen; terminal clasp segment short, stout, bidentate; dorsal plate divided, the lobes irregularly orbicular, sparsely setose; ventral plate deeply and triangularly incised, the lobes irregularly rounded and sparsely setose.

Female.—Length 4.5 mm. Antennæ dark brown, the third segment having a length about six times its diameter, the terminal segment globose. Other characters practically as in the male.

Reared by L. H. Weld of Illinois from a green, fleshy, stem gall on white snake root, *Eupatorium urticæfolium* collected at Medina, N. Y. Allied to *A. helianthifloræ* Felt. Type C. 1288.

Asphondylia thalictri n. sp. *Male.*—Length 3 to 3.5 mm. Antennæ dark brown; fourteen segments, the third with a length about five times its diameter, the terminal segment reduced, with a length about two and one half times its diameter and tapering to a conical apex. Palpi; first segment subquadrate, the second with a length about four times its diameter, rather stout, the third one fourth longer than the second, more slender. Mesonotum a dark or slaty brown. Scutellum yellowish brown, postscutellum reddish brown. Abdomen dark brown, rather thickly clothed with pale yellowish hairs. Genitalia fuscous. Wings hyaline, costa light straw. Halteres yellowish basally, fuscous or reddish brown apically. Coxæ and femora basally pale straw, the distal portion of femora and tibiæ a fuscous straw, the tarsi a little darker. Claws rather stout, strongly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment stout, terminal clasp segment short, greatly swollen, bidentate; dorsal plate short, divided, the lobes broadly orbicular and coarsely setose; ventral plate narrowly divided, the lobes narrowly triangular and thickly setose; style short, stout.

Reared from distorted seed capsules of Thalictrum collected by Miss Cora H. Clarke, Magnolia, Mass. Allied to *A. hydrangeæ* Felt. Type C. a2211.

Bruggmanniella mexicana n. sp. *Male.*—Length 2 mm. First antennal segment slightly obconic, with a length twice its diameter, the second subcylindric, with a length a little less than its diameter, other segments missing. Palpi; first segment irregularly triangular, the second rectangular, with a length over three times its width, the third a little longer and more slender than the second. Mesonotum reddish brown, the submedian lines slaty, sparsely haired. Scutellum yellowish, brownish subapically, sparsely haired; postscutellum reddish brown. Abdomen rather thickly haired, dark brown. Wings rather thickly haired, hyaline, except for the rather fuscous subcostal cell; costa yellowish brown, subcosta uniting therewith at the basal third, the third vein at the apex, the fifth at the distal fourth, its branch near the basal half. Halteres yellowish transparent, slightly fuscous subapically. Coxæ fuscous yellowish, the anterior femora and tibiæ mostly dark brown, the tarsi yellowish brown; the middle and posterior femora yellowish brown, with the distal fourth fuscous; the posterior tibiæ dark brown, the posterior tarsi with the first segment white and the second to fifth yellowish; claws rather long, slender, slightly curved, simple, the pulvilli rudimentary. Genitalia; basal clasp segment greatly swollen, stout as in Asphondylia; terminal clasp segment short, stout as in Asphondylia but with the heavily chitinized apex pectinate; dorsal plate short, emarginate, the lobes broadly rounded, other organs indistinct.

Reared from an irregular stem gall on wait-a-bit, probably *Pisonia aculeata* collected by Dr. E. A. Schwarz at Tampico, Mexico. Type C. a2119.

Contarinia spiraeina n. sp. *Male.*—Length 1.25 mm. Antennæ yellowish brown; fourteen segments, the fifth having the basal portion of the stem with a length one fourth greater than its diameter, the distal part with a length two and one fourth

times its diameter; each enlargement subglobose, with a sparse subbasal whorl of moderately stout setæ and a circumfilum, the loops of the latter rather stout and extending to the succeeding enlargement; terminal segment having the basal portion of the stem with a length about twice its diameter, the distal enlargement produced, fusiform, with a length about twice its diameter. Palpi; first segment stout, swollen distally, second rectangular, with a length nearly three times its diameter, the third one third longer than the second, more slender, the fourth one fourth longer than the third, somewhat dilated. Mesonotum slaty brown. Scutellum reddish, thickly setose; postscutellum reddish brown. Abdomen sparsely setose, a nearly uniform yellowish red. Wings hyaline, costa yellowish brown, the third vein uniting with the margin just beyond the apex of the wing. Halteres reddish brown, yellowish apically. Coxæ slaty brown; femora, tibiæ and tarsi reddish yellow, the femora and tibiæ somewhat darker apically; claws slender, evenly curved, the pulvilli as long as the claws. Genitalia; basal clasp segment moderately stout; terminal clasp segment stout, moderately long; dorsal plate short, triangularly emarginate, the lobes broadly rounded, setose; ventral plate deeply and triangularly emarginate, the lobes slender and narrowly rounded apically; style short, tapering, subacute.

Female.—Length 1.5 mm. Antennæ dark brown; fourteen subsessile segments, the fifth having a stem about one sixth the length of the subcylindric basal enlargement, which latter has a length two and one half times its diameter, and a thick subapical band of short, stout setæ; circumfili well developed, rather high; terminal segment cylindric, with a length nearly three times its diameter and tapering to a narrowly rounded apex. Palpi; nearly as in the male. Mesonotum slaty brown, the yellowish submedian lines thickly setose. Scutellum reddish brown, thickly setose; postscutellum reddish brown. Abdomen sparsely setose, the dorsal sclerites dark reddish brown, the venter reddish orange. Halteres yellowish brown. Coxæ slaty brown. Legs mostly yellowish brown, the tibiæ and tarsi somewhat darker apically. The slender ovipositor one half longer than the body; terminal lobes with a length six times the width, subacute, sparsely setose.

Reared from cabbage-like, bud galls on Spiraea collected by Miss Cora H. Clarke, at Magnolia, Mass. Type C. a2142.

Dicrodiplosis coccidarum n. sp. *Female.*—Length 1.5 mm. Antennæ dark brown; probably fourteen segments, the fifth with a stem about one fourth the length of the cylindric basal enlargement, which latter has a length about one half greater than its diameter, a thick subapical band of shorter, fine setæ. The circumfili are unusual in that the basal filum bends strongly towards the apex of the segment and in some instances anastomoses irregularly, the distal circumfili has rather high loops. Palpi; first segment subquadrate, the second narrowly oval, the third rectangular, with a length nearly three times its diameter, the fourth fusiform and about as long as the third. Mesonotum dark brown, the submedian lines indistinct. Scutellum reddish brown, postscutellum yellowish. Abdomen sparsely haired, dark brown. Wings hyaline, costa pale yellowish, subcosta uniting therewith before the basal half, the third vein at the apex, the fifth at the distal fourth, its branch near the basal half. Legs a variable yellowish transparent, the middle claw at least stout, strongly curved, unidentate, the pulvilli about half the length of the claws. Ovipositor short, the terminal lobes narrowly oval, with a length about twice the width and thickly setose.

Presumably reared from a scale insect by August Busck and labeled

Diplosis coccidarum Mayaguez, Porto Rico. Loaned for study by U. S. National Museum. Type C. 970.

Dicrodiplosis gillettei n. sp. *Female.*—Length nearly 2 mm. Antennæ dark brown, yellowish basally; fourteen segments, the fifth with a stem one fourth the length of the cylindric basal enlargement, which latter has a length about thrice its diameter; terminal segment apically with a short, stout process. Palpi; first segment subquadrate, the second with a length about three times its diameter, the third a little longer, more slender, the fourth a little longer than the third and somewhat dilated. Mesonotum slaty brown, the submedian lines reddish orange. Scutellum brownish red, postscutellum dark brown. Abdomen reddish salmon. Wings hyaline. Costa, light straw. Halteres yellowish basally, reddish apically. Coxæ dark reddish, the femora mostly pale straw; tibiæ fuscous straw, the tarsi slightly darker. Claws slender, strongly curved, unidentate, the pulvilli a little longer than the claws. Ovipositor short, the terminal lobes with a length about three times the width, sparsely setose.

Reared from an apical, bud-like deformity on *Pinus scopulorum*. collected by Prof. C. P. Gillette, Fort Collins, Col. Allied to *D. rubida* Felt. Type C. a2205.

Mycodiplosis carolina n. sp. *Male.*—Length 1.25 mm. Antennæ pale yellowish; fourteen segments, the fifth having the basal portion of the stem with a length thrice its diameter, the distal part with a length three and one half times its diameter; basal enlargement subglobose, subbasal whorl rather thick, the circumfilum with long loops extending to the produced distal enlargement, which latter has a length one half greater than its diameter, a sparse whorl of long setæ and subbasal and subapical circumfili, the loops of the last extending to the apex of the segment; terminal segment produced, the basal portion of the stem with a length five times its diameter, the distal enlargement cylindric, with a length nearly four times its diameter and apically a long, slender, finger-like process. Palpi; first segment irregularly subquadrate, the second fusiform, with a length over three times its diameter, the third one half longer than the second, more slender, the fourth a little longer than the third, more slender. Body pale yellowish. Wings yellowish, costa light brown, the third vein uniting with the margin well beyond the apex. Halteres yellowish transparent. Legs pale yellowish; claws slender, strongly curved, the anterior and mid unidentate, the pulvilli shorter than the claws. Genitalia; basal clasp segment rather stout, truncate; terminal clasp segment long, swollen basally; dorsal plate rather short, broad, triangularly emarginate, the lobes broadly and roundly emarginate; internal and external angles slightly produced, subequal and sparsely setose; ventral plate long, expanded apically, broadly rounded and finely setose. Harpes short, subtriangular; style long, tapering, narrowly rounded apically.

Reared by Theodore Pergande from leaves of *Lilium superbum* received from H. P. Kelsey, Kawani, N. C. Loaned for study by the U. S. Bureau of Entomology. Allied to *M. robusta* Felt. Type C. 976.

Mycodiplosis coccidivora n. sp. *Male.*—Length 1 mm. Antennæ missing. Mesonotum light brown. Scutellum and postscutellum yellowish brown. Abdomen

reddish brown. Wings hyaline, costa dark brown, the third vein uniting with the margin at the apex of the wing. Halteres pale yellowish. Legs mostly a fuscous yellowish, the distal tarsal segments somewhat darker; claws rather stout, strongly curved, the anterior unidentate, the pulvilli rudimentary. Genitalia; basal clasp segment stout, with a length only a little over twice its diameter; terminal clasp segment short and relatively stout; dorsal plate short, broad, deeply and triangularly incised, the lobes narrowly rounded and sparsely setose; ventral plate moderately long, broad, broadly rounded or slightly truncate distally and sparsely setose.

Female.—Length 1 mm. Antennæ reddish brown, the basal segments yellowish; fourteen segments, the fifth with a stem one third the length of the cylindric basal enlargement, which latter has a length about one half greater than its diameter, is slightly swollen near the middle, subbasal whorl sparse, a thick subapical band of long, curved setæ. Palpi; first segment subquadrate, with a length one fourth greater than its width, the second irregularly suboval, the third one half longer than the second, slightly expanded distally, the fourth about as long as the third, more slender. Face yellowish; eyes black. Mesonotum reddish brown, the submedian lines indistinct, yellowish brown. Scutellum and postscutellum yellowish. Abdomen reddish brown, the basal segment and the second segment laterally yellowish. Wings hyaline, with violaceous reflections in certain lights. Halteres yellowish. Coxæ and femora basally pale straw, the femora distally, tibiæ and tarsi mostly reddish brown; claws moderately stout, strongly curved, the anterior unidentate, the pulvilli rudimentary. Ovipositor short, the terminal lobes narrowly oval, with a length nearly twice the width.

Reared by Prof. T. D. A. Cockerell from the ovisac of *Pulvinaria urbicola* taken on capsicum at Kingston, Jamaica, W. I. and labeled *Diplosis coccidarum* Ckll. This is very different from what we take to be the true *Diplosis coccidarum* Ckll., a species reared from Dactylopius. Type C. 969.

Mycodiplosis cucurbitae n. sp. *Female.*—Length 1 mm. Antennæ light brown; fourteen segments, the fifth with a stem one third the length of the cylindric basal enlargement, which latter has a length two and one half times its diameter; subbasal whorl sparse, subapical band sparse, the setæ strongly curved; terminal segment produced, the basal enlargement with a length four times its diameter. Apically there is a long, finger-like process, the latter swollen basally. Palpi; first segment subquadrate, the second narrowly oval, with a length fully twice its diameter, the third as long as the second and the fourth a little longer and more slender than the third. Mesonotum yellowish brown, the submedian lines, scutellum and postscutellum yellowish. Abdomen yellowish brown, thickly haired. Wings hyaline, costa light straw, the third vein uniting with the margin beyond the apex. Halteres whitish transparent. Legs a variable yellowish brown, the distal tarsal segments darker; claws very long, slender, evenly curved, the anterior and mid unidentate, the tooth long and slender. Ovipositor short, the terminal lobes narrowly oval and sparsely setose.

Reared by the late C. V. Riley from orange larvæ on a squash having a curious rough, fulvous appearance. Loaned for study by the U. S. Bureau of Entomology. Type C. 966a.

Mycodiplosis spinosa n. sp. *Male.*—Length .9 mm. Antennæ light brown; fourteen segments, the fifth having the basal portion of the stem with a length twice

its diameter, the distal part with a length two and one half times its diameter; basal enlargement subglobose, with a sparse subbasal whorl of stout setæ and a subapical circumfilum, the loops hardly extending beyond the tip of the swelling, the distal enlargement with a length one half greater than its diameter, a rather thick whorl of slender setæ and subbasal and subapical circumfili, the loops of the latter extending to the apex of the segment. Palpi; first segment subquadrate, the second with a length three times its diameter, the third a little longer than the second, more slender, the fourth a little longer than the third, somewhat dilated. Mesonotum reddish brown, the submedian lines yellowish. Scutellum yellowish, postscutellum yellowish brown. Abdomen rather thickly haired, dark reddish brown. Wings hyaline, costa light brown, the third vein uniting with the margin a little before the apex. Halteres whitish transparent. Femora and tibiae a light straw, the tarsi mostly light brown, the distal segments somewhat darker; claws long, slender, evenly curved, the anterior and mid probably unidentate, the pulvilli as long as the claws. Genitalia; basal clasp segment long, slender, truncate; terminal clasp segment rather long and slender; dorsal plate short, deeply and triangularly emarginate, the lobes triangular and sparsely setose; ventral plate long, broad, broadly truncate and sparsely setose apically. Harpes rather stout, tapering, coarsely spined apically; style long, tapering to a narrowly rounded apex.

Female.—Length 1 mm. Antennæ light brown; fourteen segments, the fifth having a stem one fourth the length of the cylindric basal portion, which latter has a length two and one half times its diameter and sparse subbasal and subapical whorls of stout setæ. Palpi probably as in the male. Mesonotum yellowish brown. Scutellum yellowish, postscutellum yellowish brown. Abdomen reddish brown, the basal segments yellowish. Ovipositor short, terminal lobes narrowly lanceolate, with a length fully twice the width, thickly setose.

Reared from oats without any indication as to locality or date. Loaned for study by the U. S. Bureau of Entomology. Type C. 955.

Youngomyia quercina n. sp. *Male.*—Length 2 mm. Antennæ reddish brown; fourteen segments, the fifth trinodose, the two portions of the stem, each with a length about two and one half times the diameter; basal enlargement subglobose, with a thick subbasal whorl of long, stout setæ and a subapical circumfilum, the loops extending nearly to the base of the distal enlargement, which latter is deeply though narrowly constricted near the basal third, has subbasal and subapical whorls of long, stout setæ and similar circumfili, the loops of the distal circumfilum extending to the tip of the segment; terminal segment greatly produced, the basal portion of the stem with a length six times its diameter, the distal enlargement greatly produced, strongly constricted near the basal third, and apically with a long, finger-like process with a length fully six times its diameter and but slightly swollen basally. Palpi; first segment subquadrate, the second with a length five times its diameter, the third and fourth more slender, each a little shorter than the second. Mesonotum light yellowish red. Scutellum and postscutellum pale yellowish. Abdomen sparsely haired, a variable yellowish brown, the distal segments somewhat darker. Wings hyaline, costa light brown. Halteres pale yellowish. Legs a nearly uniform light brown; claws stout, strongly curved, unidentate, the pulvilli about two thirds the length of the claws. Genitalia; basal clasp segment short, stout, truncate, the basal lobe rounded; terminal clasp segment one half longer than the basal, long, stout, curved; dorsal plate broadly and triangularly emarginate, the lobes sparsely setose internally; ventral plate rather short, stout, broadly rounded and thickly setose apically. Harpes thickly setose; style long, stout, expanded distally.

Reared by Theodore Pergande from lobulate leaf galls on running oak, *Quercus pumila* collected by Mr. Koeble at Donner, Cal. Loaned for study by the U. S. National Museum. Type C. 1009.

Youngomyia vernoniae n. sp. *Male.*—Length 2 mm. Antennæ pale yellowish; fourteen segments, the flagellate ones trinodose, the fifth having the basal portion of the stem with a length one half greater than its diameter, a well marked constriction in the middle of the distal enlargement, its length being half its diameter, while the distal portion of the stem has a length two and one half times its diameter; basal enlargement globose, with a sparse subbasal whorl of stout setæ and a rather slender circumfilum, the loops extending to the base of the distal enlargement, which latter has subbasal and subapical circumfili, the loops of the latter extending to the apex of the segment; terminal segment greatly produced, the basal portion of the stem with a length five times its diameter, the constriction of the distal enlargement with a length one half greater than its diameter; apically there is a long, finger-like process with a length six times its diameter. Palpi; first segment irregularly oval, the second longer than the first, dilated apically, the third and fourth subequal, slender. Mesonotum pale yellowish brown. Scutellum, postscutellum and abdomen yellowish brown, the last with the third and fourth segments dark brown; genitalia yellowish. Wings hyaline, costa light brown. Halteres yellowish transparent. Legs a nearly uniform yellowish straw; claws stout, rather strongly curved, the anterior unidentate, the pulvilli about half the length of the claws. Genitalia; basal clasp segment stout, truncate distally; terminal clasp segment one half longer, rather slender, curved; dorsal plate broadly and triangularly emarginate, the lobes thickly clothed internally with stout, tapering setæ; ventral plate long, broadly rounded apically and thickly clothed distally with stout, tapering setæ; style long, stout, expanded distally.

Female.—Length 2.5 mm. Antennæ light fuscous; fourteen segments, the fifth with a stem one fourth the length of the subcylindric basal enlargement, which latter has a length about three and one half times its diameter; terminal segment produced, the basal enlargement subcylindric, with a length nearly five times its diameter and apically a long, slender, finger-like process, swollen basally. Palpi; first segment with a length nearly three times its diameter, the second about twice the length of the first, the third and fourth subequal. Mesonotum light reddish brown. Scutellum pale yellowish; postscutellum yellowish brown. Abdomen rather thickly haired, dark yellowish brown. Wings with costa pale yellowish. Halteres yellowish transparent. Legs a nearly uniform light yellowish brown. Ovipositor short; terminal lobes large, suborbicular, thickly clothed with short, stout setæ.

Reared from blossoms of *Vernonia noveboracensis* collected in Virginia and loaned for study by the U. S. National Museum. Type C. 973.

Hyperdiplosis fungicola n. sp. *Male.*—Length 1 mm. Antennæ yellowish white; fourteen segments, the fifth having the basal portion of the stem with a length nearly three times its diameter, the distal part with a length about two and one half times its diameter; basal enlargement subglobose, subbasal whorl rather sparse, the subapical circumfilum with loops extending nearly to the base of the produced distal enlargement, which latter has a length about one half greater than its diameter, a sparse whorl of stout setæ, subbasal and subapical circumfili, the loops

of the latter extending nearly to the apex of the segment; terminal segment produced, the basal portion of the stem with a length about five times its diameter, the distal enlargement cylindric with a length about three times its diameter and apically with a finger-like process. Palpi; first segment irregularly subquadrate, the second with a length more than twice the first, the third as long as the second, the fourth a little longer than the third. Mesonotum yellowish brown. Scutellum and postscutellum a pale yellowish. Abdomen yellowish white, sparsely haired. Wings whitish, costa yellowish white, the third vein uniting with the margin well beyond the apex. Halteres whitish transparent. Legs yellowish white, the distal tarsal segments a light straw; claws long, slender, very strongly curved, simple, the pulvilli as long as the claws. Genitalia; basal clasp segment long, truncate; terminal clasp segment short, tapering from a swollen base; dorsal plate short, deeply and triangularly incised, the lobes truncate, with the lateral angles slightly produced, they and the internal angles sparsely setose; ventral plate long, very deeply and roundly emarginate, the slender lobes diverging and sparsely setose; style long, curved, narrowly rounded apically.

Reared from larvae on the surface of a nearly rotten fungous affected nectarine received at the Bureau of Entomology from Mrs. R. B. Tenney, Washington, D. C. Type C. 977.

Parallelodiplosis clarkeæ n. sp. *Male.*—Length 1.5 mm. Antennæ fuscous yellowish, yellowish basally; fourteen segments, the fifth having the basal portion of the stem with a length two and one half times its diameter, the distal part with a length three and one half times its diameter; basal enlargement globose, with a sparse subbasal whorl of stout setæ and a subapical circumfilum, the stout loops extending to the distal enlargement, which latter has a length one half greater than its diameter, a sparse whorl of setæ and basal and subapical circumfili, the loops of the former extending beyond the apex of the enlargement, those of the latter a little beyond the tip of the segment; terminal segment with the distal enlargement cylindric, with a length about two and one half times its diameter and a finger-like process apically. Palpi yellowish; first segment subquadrate, the second with a length about twice that of the first, the third as long as the second, the fourth about one half longer than the third. Mesonotum fuscous yellowish. Scutellum and postscutellum a little darker. Abdomen a fuscous yellowish, the genitalia darker. Costa light straw, the third vein joining the margin well beyond the apex of the wing. Halteres yellowish basally, slightly fuscous apically. Legs mostly a fuscous straw; claws rather stout, strongly curved, slightly swollen near the middle, the pulvilli about one half the length of the claws. Genitalia; basal clasp segment rather long, stout, truncate, terminal clasp segment long, curved; dorsal plate short, broad, triangularly incised, the lobes broad, broadly and deeply emarginate, the produced angles with stout setæ apically; ventral plate long, rather broad, broadly and roundly emarginate. Style long, slender, broadly rounded distally.

Female.—Length 1.75 mm. Antennæ fuscous yellowish, yellowish basally; fourteen segments, the fifth with a stem about three fourths the length of the cylindric basal enlargement, which latter has a length thrice its diameter, a scattering subapical band of long, stout setæ; terminal segment produced, the cylindric basal portion with a length fully five times its diameter, apically a long, slender, finger-like process. Palpi yellowish; first segment rectangular, the second twice the length of the first, the third as long as the second, the fourth one half longer than the third. Mesonotum reddish brown, sparsely haired, submedian lines yellowish. Scutellum

and postscutellum fuscous yellowish. Abdomen a light fuscous yellowish orange. Costa fuscous straw. Ovipositor rather stout and when extended about half the length of the abdomen, the terminal lobes narrowly lanceolate, with a length nearly three times the width, rather thickly setose apically. Other characters about as in the male.

Reared from a narrow, clustered apical bud gall on *Spiraea salicifolia* collected by Miss Cora H. Clarke of Magnolia, Mass. Allied to *P. pratensis* Felt. Type C. a2074.

Cecidomyia cerasiphila n. sp. *Female.*—Length 2.5 mm. Antennæ black; fourteen segments, the fifth with a stem one fourth the subcylindric basal enlargement, which latter has a length twice its diameter, is slightly constricted near the middle and has sparse subbasal and subapical whorls of setæ; terminal segment somewhat produced, with a length two and one half times its diameter and tapering to an obtusely rounded apex. Face pale reddish yellow. Palpi pale reddish yellow; first segment irregularly subquadrate, the second stouter, with a length fully twice its diameter, the third a little longer, more slender, the fourth nearly twice the length of the third, greatly dilated. Mesonotum black, the submedian lines fuscous. Scutellum and postscutellum fuscous yellowish. Abdomen dark red. Wings hyaline, costa pale straw, the third vein uniting therewith well beyond the apex. Halteres reddish orange. Legs reddish yellow; the femora near the tip, and the two anterior pair of tibiæ and all of the tarsi dusky; claws stout, strongly curved, simple, the pulvilli longer than the claws. Ovipositor greatly produced, with a length fully one half greater than the body; terminal lobes slender, with a length six times their diameter, sparsely setose apically. Colors by Pergande.

Reared by Theodore Pergande from swollen fruits of wild cherry. Loaned for study by U. S. Bureau of Entomology. Type C. 879.

Cecidomyia hopkinsi n. sp. *Female.*—Length 1.5 mm. Antennæ light brown; fourteen segments, the fifth with a stem about three fourths the length of the subcylindric basal enlargement, which latter has a length fully twice its diameter, is slightly constricted near the basal third and has rather thick subbasal and subapical whorls of long, stout setæ; terminal segment with a length four times its diameter, tapering distally to a rounded apex. Palpi; first segment irregularly subquadrate, the second with a length fully three times its diameter, rather stout, the third short, more slender than the second and the fourth about as long as the third, dilated. Mesonotum reddish brown, the yellowish submedian lines rather thickly haired. Scutellum fuscous yellowish, postscutellum a little darker. Abdomen rather thickly haired, reddish brown, darker laterally. Wings brownish, subhyaline, indistinctly spotted, there being indistinctly broken, transverse bands near the middle and at the distal fourth, the spot in each near the anterior margin, approximately at the middle and on the posterior margin; the third vein unites with the margin at the apex of the wing. Halteres pale yellowish, slightly fuscous subapically. Legs dark brown and annulate with yellowish as follows: A narrow band near the middle of femora; broad subbasal and subapical bands on tibiæ; narrow basal bands on the first and second tarsal segments; a broad band on the middle of the second tarsal segment and narrow indistinct ones basally on the third tarsal segment. Claws rather long, slender, evenly curved, simple, the pulvilli nearly as long as the claws. Ovipositor short, the terminal lobes broadly oval and sparsely setose.

Reared from Scolytid burrows in *Pinus attenuata* collected by Dr. A. D. Hopkins, at San Francisco, Cal. Loaned for study by the U. S. Bureau of Entomology. Type C. 988, 1004.

Itonida cucurbitae n. sp. *Male*.—Length 1 mm. Antennæ with fourteen segments, the fifth having the basal portion of the stem with a length twice its diameter, the distal part with a length three times its diameter; basal enlargement subglobose, the subbasal whorl rather thick, subapical circumfilum with loops extending to the base of the produced distal enlargement, which latter has a length one half greater than its diameter, a rather thick whorl of stout setæ and subbasal and subapical circumfili, the loops of the latter extending to the apex of the segment. Palpi probably quadriarticulate. Mesonotum yellowish brown, the submedian lines, scutellum and postscutellum fuscous yellowish. Abdomen yellowish brown, rather thickly clothed with yellowish hairs. Wings hyaline, costa light straw, the third vein uniting with the margin well beyond the apex. Halteres whitish transparent. Legs a light yellowish brown, the distal tarsal segments darker; claws rather long, stout, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment short, strongly curved, truncate; terminal clasp segment long, slightly swollen basally; dorsal plate rather long, deeply and triangularly emarginate, the lobes broadly rounded; ventral plate rather long, broadly rounded; both plates sparsely setose. Harpes rather long, tapering, obtuse; style short, tapering to a subacute apex.

Female.—Length 1 mm. Antennæ light brown; fourteen segments, the fifth with the stem one fourth the length of the cylindric basal enlargement, which latter has a length about four times its diameter, is slightly constricted near the middle; subapical band scattering, the setæ strongly curved; terminal segment produced, the basal enlargement with a length five times its diameter; apically there is a long, finger-like appendage, the latter swollen basally. Palpi; first segment subquadrate, the second with a length three times its diameter, the third as long as the second, more slender, the fourth longer than the third. Ovipositor short, the terminal lobes narrowly oval and sparsely setose. Other characters practically as in the opposite sex.

Reared from orange larvae from a squash having a curious rough, fulvous appearance. Loaned for study by U. S. Bureau of Entomology. *Mycodiplosis cucurbitae* Felt was associated with this form. Type C. 966.

Itonida spiraeina n. sp. *Male*.—Length 1.5 mm. Antennæ dark brown, yellowish basally; fourteen segments, the fifth binodose, the basal portion of the stem with a length thrice its diameter, the distal part with a length four and one half times its diameter; the basal enlargement subglobose, the distal subcylindric, with a length one half greater than its diameter, the whorls of setæ long and stout; circumfili with the loops long, stout and rather sparse; terminal segment produced, the distal enlargement with a length three times its diameter and with a long, tapering apical process. Palpi fuscous yellowish; first segment irregular, fusiform, the second one half longer than the first, the third a little longer than the second, the fourth about as long as the third; face and mesonotum fuscous yellowish, the submedian lines yellowish, sparsely haired. Scutellum fuscous yellowish, setose apically; postscutellum yellowish white. Abdomen sparsely haired, fuscous yellowish, the incisures and pleuræ yellowish, the distal segments deep orange. Wings relatively broad,

costa dark brown, subcosta at the basal third, the third vein well beyond the apex. Halteres yellowish basally, fuscous apically. Coxæ fuscous yellowish. Legs fuscous straw, the distal tarsal segments darker; claws slender, evenly curved, simple, the pulvilli rudimentary. Genitalia fuscous, setose; basal clasp segment long, rather slender; terminal clasp segment long, slender; dorsal plate rather short, broad, triangularly emarginate, the lobes broadly and roundly emarginate, setose apically; ventral plate long, broad, deeply and roundly emarginate; style stout, broadly rounded apically.

Female.—Length 1.75 mm. Antennæ fuscous, whitish basally; fourteen segments, the fifth with a stem about three fourths the length of the cylindric basal enlargement, which latter has a length four times its diameter; subapical band scattering; terminal segment slightly produced, basal enlargement fusiform, with a length three times its diameter and apically with a long, slender, irregular appendage. Palpi; the first segment irregular, the second with a length four times its diameter, the third and fourth subequal, the latter dilated apically; face fuscous yellowish, the mouth-parts apically deep carmine. Mesonotum fuscous yellowish, the submedian lines sparsely haired, yellowish. Scutellum and postscutellum fuscous yellowish. Abdomen light fuscous, the incisures and pleuræ fuscous yellowish, the distal segments with a reddish tinge. Halteres yellowish basally, fuscous apically. Coxæ fuscous yellowish, tarsi fuscous straw, the distal tarsal segments darker. Claws stout, strongly curved, simple, the pulvilli about half the length of the claws. Ovipositor yellowish, short, the terminal lobes with a length about four times the width, setose; minor lobes short, broad, setose.

Reared from bud galls, 3 mm. in diameter, on *Spiraea salicifolia* collected by Miss Cora H. Clarke at Magnolia, Mass. Allied to *I. apocyni* Felt. Type C. a1759x.

Itonida taxodii n. sp. *Male.*—Length 1.5 mm. Antennæ fuscous yellowish, the fifth segment having the basal part of the stem with a length one half greater than its diameter, the distal part with a length three times its diameter, the basal enlargement subglobose, the subbasal whorl moderately thick, stout, the circumfilum stout, the loops moderately long; the distal enlargement cylindric, with a length one half greater than its diameter, the whorl rather thick, the setæ stout and longer on one face; the loops of the distal circumfilum slightly produced on one face; terminal segment produced, the basal portion of the stem with a length three times its diameter, the distal enlargement constricted near the basal fourth and with a short, stout knob subapically. Palpi; first segment short, stout, the second broadly oval, the third a little longer, more slender, the fourth more than twice the length of the third. Mesonotum apparently fuscous, the submedian lines yellowish. Scutellum and postscutellum presumably a pale yellowish. The abdomen probably fuscous yellowish; genitalia presumably yellowish. Wings hyaline, costa pale straw, subcosta uniting therewith before the basal half, the third vein at the apex. Halteres yellowish. Legs apparently nearly a uniform yellowish, the claws strongly curved, slightly dilated subapically, the pulvilli distinctly shorter than the claws. Genitalia obscure in the preparation.

Female.—Length 2 mm. Antennæ light brown; fourteen segments, the fifth with a short stem one fifth the length of the cylindric basal enlargement, which latter has a length four times its diameter, is broadly constricted near the basal third; subbasal whorl sparse, stout, subapical whorl scattering, stout; rather distinct circumfili occur at the basal half and apically; terminal segment produced, with a

length five times its diameter, tapering from the distal fourth to the narrowly rounded apex. Palpi; first segment short, stout, the second one half longer, slender, the third one half longer than the second, more slender, the fourth a little longer and more slender than the third. Mesonotum reddish brown, the submedian lines fuscous yellowish, sparsely haired. Scutellum light yellowish brown, postscutellum yellowish brown. Abdomen rather dark yellowish brown. Halteres pale yellowish. Legs a nearly uniform reddish brown; claws strongly curved, distinctly swollen near the basal third, simple, the pulvilli rudimentary. Ovipositor nearly as long as the abdomen, the distal portion unusually stout; the lobes slender, with a length five times the width, narrowly rounded apically, minor lobes long, slender.

Reared from leaves of bald cypress, *Taxodium distichum* collected by Mr. H. G. Hubbard in Florida. Loaned for study by the U. S. Bureau of Entomology. Type C. 1038.

Itonida pugionis n. sp. *Male.* Length 1.75 mm. Antennæ one fourth longer than the body, rather thickly haired, the basal enlargements fuscous, the distal yellowish; fourteen segments, the fifth having the basal portion of the stem with a length twice its diameter, the distal part with a length two and one half times its diameter; terminal segment produced, the basal portion of the stem with a length nearly four times its diameter, the distal part cylindric, with a length fully three times its diameter and apically tapering suddenly to a narrowly rounded apex. Palpi; first segment subquadrate, the second with a length about twice the first, the third about as long as the second, more slender, the fourth slightly longer than the third and more slender, Mesonotum yellowish brown, slightly fuscous, the submedian lines thickly haired. Scutellum reddish orange, sparsely setose apically, postscutellum fuscous yellowish. Abdomen sparsely haired, a light fuscous orange, the pluræ rather thickly clothed with fuscous scales and appearing as a longitudinal broken, broad, fuscous stripe; venter fuscous yellowish, the sclerites somewhat darker. Wings distinctly yellow tinted, costa yellowish; near the center of the wing and at the apex of the reddish third vein, a distinct, black spot, a similar one, slightly produced, at the apex of the fifth vein, the fork of the latter and its branch covered by a dagger-like fuscous spot. Halteres yellowish orange, yellowish transparent apically. Coxæ fuscous; anterior and mid-femora mostly fuscous brown, the latter slightly yellowish apically, the posterior femora mostly yellowish; anterior tibiæ fuscous, the mid- and posterior tibiæ yellowish basally, fuscous apically, the first tarsal segment and the basal two thirds of the second fuscous, the distal third yellowish, the third and fourth tarsal segments yellowish orange, fuscous basally, the fifth reddish brown, somewhat fuscous basally. Claws rather slender, evenly curved, simple, the pulvilli nearly as long as the claws. Genitalia; basal clasp segment long, rather slender; terminal clasp segment slightly swollen basally, long, slender; dorsal plate long, deeply and triangularly emarginate, the lobes tapering irregularly, rounded; ventral plate long, broad, narrowly rounded.

Female. Length 2.75 mm. Antennæ nearly as long as the body, sparsely light-haired, the enlargements dark brown, the stems whitish transparent, the stem of the fifth segment with a length equal to the subcylindric basal enlargement, which latter has a length two and one-half times its diameter, is strongly constricted near the middle and has, for a female, high subbasal and subapical circumfili, the loops stout and relatively broad; terminal segment subcylindric, produced, with a length four times its diameter, tapering apically to a narrowly rounded extremity. Coxæ fuscous yellowish; femora fuscous basally, yellowish apically; tibiæ yellowish basally,

fuscous apically, the first tarsal segment, the basal two thirds of the second, a narrow basal band on the third and fourth, and most of the fifth tarsal segments fuscous, the remainder yellowish. Ovipositor short, the terminal lobes narrowly lanceolate. Otherwise nearly as in the male.

Reared from jars containing chestnut and maple bark infested with numerous *Miastor americana* Felt larvæ. Type C. a2150 Y.

Itonida cincta n. sp. *Female*. Length 1.5 mm. Antennæ nearly as long as the body, sparsely haired, pale yellowish, the segments fuscous basally; fourteen segments, the fifth with a stem one third the length of the subcylindric basal enlargement, which latter has a length nearly three times its diameter; terminal segment produced, with a length six times its diameter, tapering to a subacute apex. Palpi; first segment short, stout, the second narrowly oval, with a length over twice its diameter, the third one half longer, more slender, the fourth one fourth longer than the third, more slender. Mesonotum yellowish brown. Scutellum and postscutellum pale yellow. Abdomen yellowish brown, the ovipositor orange red. Wings subhyaline, yellowish, distinctly marked with brown, there being a diffuse fuscous area near the basal fourth and extending to the posterior basal angle; another broad, diffuse band extends obliquely across the middle of the wing to the branching of the fifth vein; the apical fourth of the wing is mostly fuscous, except for an oval space near the distal ninth and close to costa, and a similar one midway between the third and fifth veins; an irregular though dark patch lies near the middle of the wing between the third and fifth veins. Legs banded, dark brown, the tibiæ with basal and subapical light bands, the posterior tarsi with first segment and the base of the second, third and fourth segments and all of the fifth yellowish white, the anterior tarsi with a broad band near the middle of the second and at the base of the third and fourth segments, the fifth silvery white. Ovipositor about as long as the abdomen, stout, the terminal lobes narrowly oval.

Reared from larvæ occurring under oak bark. Type C. 1074.

Itonida canadensis n. sp. *Male*. Length 1.5 mm. Antennæ one half longer than the body, rather thickly haired, light fuscous yellowish; fourteen segments, the fifth having the basal part of the stem with a length two and one half, the distal part, with a length three and one half times its diameter. Palpi; the first segment probably subquadrate, the second broadly oval, the third with a length about three times its diameter, the fourth one half longer than the third. Face whitish transparent. Thorax a nearly uniform yellowish transparent. Abdomen a variable pale yellowish, the basal and distal segments pale orange. Wings hyaline, yellowish; costa orange yellow, subcosta at the basal third, the third vein well beyond the apex. Halteres yellowish transparent. Coxæ pale yellowish; femora and tibiæ pale yellowish straw; tarsi mostly a very light brown, the distal segments somewhat darker; claws strongly curved basally, simple, the pulvilli about half the length of the claws. Genitalia; basal clasp segment long, slender, terminal clasp segment long; dorsal plate broad, deeply emarginate, the lobes produced laterally, roundly emarginate; ventral plate long, broad, broadly and roundly emarginate.

Female. Length 1.5 mm. Antennæ one third longer than the body, sparsely haired, pale yellowish; fourteen segments, the fifth with a transparent stem as long as the cylindric basal enlargement, which latter has a length slightly over twice its diameter; terminal segment produced, with a length three times its diameter and a long, finger-like apical process. Palpi; first segment short, stout, the second with

a length about three times its diameter, the third as long as the second, the fourth about one half longer than the third. Abdominal segments sparsely margined posteriorly with whitish hairs. Ovipositor short, the lobes slender, with a length thrice the width. Otherwise nearly as in the male.

Reared from a woolly, oval gall on the lateral veins of shadbush, Amelanchier, taken by Miss Cora H. Clarke at Magnolia, Mass. Type C. a1859.

TWO NEW APHIDS FROM CALIFORNIA[1]

By W. M Davidson, *U. S. Bureau of Entomology, San José, Cal.*

So far as I can determine no plant louse has been reported from the California laurel (*Umbellularia californica* Nutt.) and so I will proceed to describe an aphid taken by me on this tree at San José, California, on July 1, 1911.

Hyadaphis umbellulariæ sp. nov.

Alate viviparous female.—Head, thorax, and abdomen green with a powdery white covering. Eyes crimson. Thoracic lobes and scutellum dark purplish-black; Head on the dorsum dark purple. Antennæ little over half the length of the body. joint III and the filament of about equal length. Comparative lengths of the joints as follows: I .09 mm., II .06 mm., III .39 mm., IV .26 mm., V .23 mm., VI .10 mm., filament .38 mm. Legs green and powdery like the body; femoral apices, tibial apices, and tarsi purplish-black. Tibiæ with two rows of spines, one on either side. Abdomen pale green with transverse white powdery bars. Cauda dusky, 0.14 mm. in length, narrow, tapering. Cornicles green, smaller than the cauda, in length 0.08 mm., broad at the base, then narrowing to two-thirds their maximum width at basal fourth, and thence widening distally so that their width at the apex equals twice that at the base. Wings large; veins pale brown, second fork of third discoidal a little nearer wing apex than first fork; stigma fairly long and narrow, green, as are also the insertions and sub-costal vein. The sensoria on the antennæ are disposed as follows: joint III has 25–30; joint IV 5–9; joint V 1 near the apex; joint VI, 1 terminal. Those on joint III are placed irregularly and are small, those on joint IV are in a single row and their size is similar to those in joint III. Beak short, reaching second coxæ, green with the extreme tip black. Mesosternum black.

Measurements of the body.—Length of body, 1.80 mm.; breadth of body, 0.65 mm.; wing expanse, 5.75 mm.

Taken on the underside of the leaves of California Laurel (*Umbellularia californica* Nutt.) July 1, 1911. Habitat: San José, California.

Cryptosiphum tahoense sp. nov.

Winged oviparous female.—Dark olive green, newly hatched specimens paler. Head, thoracic lobes and scutellum dark brown. Eyes dark red. Antennæ olive green, hardly one third as long as the body, on frontal tubercles. Ocelli distinct. Prothorax and abdomen olive green. Lateral tubercles absent. Abdomen with

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[1] Published by permission of the Chief of the Bureau of Entomology.

seven or eight indistinct transverse brown bars. Cornicles very small, hardly more than a raised rim on surface of abdomen, dusky. Cauda rounded, short, with small hairs at edge. Legs olive green with distal two thirds of the femora and coxæ darker. Wings of moderate size, insertions and costa green. Stigma short, protruding into wing at the point where it is joined by the stigmatic vein. First two discoidals rather thick, brown, with their origins close together. Third discoidal with two branches, generally obsolete at its base, second fork equidistant from first fork and apex of the wing. The subcostal vein bends slightly into the wing at the point where it receives the two discoidal veins. Hind wings with two discoidals. Sternum black. Beak not reaching second coxæ, light green. About the first of September winged females began to develop. These contained from five to seven eggs in them at that time. Sensoria on antennæ as follows: joint III, 7–9; IV, V, VI, each with one apical sensorium. All sensoria are transverse.

Measurements.—Length of body, 1.8 mm.; breadth of body, .75 mm.; expanse of wings, 4.75 mm.; antennal joints I, .06; II, .04; III, .23; IV, .13; V, .12; VI, .11; VII, .04.

Pupa.—Olive green, younger individuals pale green and with the compound eyes not fully developed. Antennæ one fourth length of body, pale green. Legs pale green, coxæ and femora darker. Wing pads olive green. Cauda and cornicles as in the winged form. Abdomen on the dorsum with seven or eight transverse rows of small brown dots which apparently become the indefinite brown bars of the winged form. Beak very short, olive green.

Viviparous apterous female.—Before depositing young, greyish-brown, abdomen much distended, with considerable reddish mottling on the dorsum of abdomen and thorax, also with eleven transverse darker bars on dorsum of abdomen and dark areas on head and thorax. Cauda dark brown, rounded, short. Cornicles as in winged female. Antennæ very small, one eighth length of body, four-jointed, pale. Legs short, olive green. Abdomen on the under side with six short median transverse dark bars.

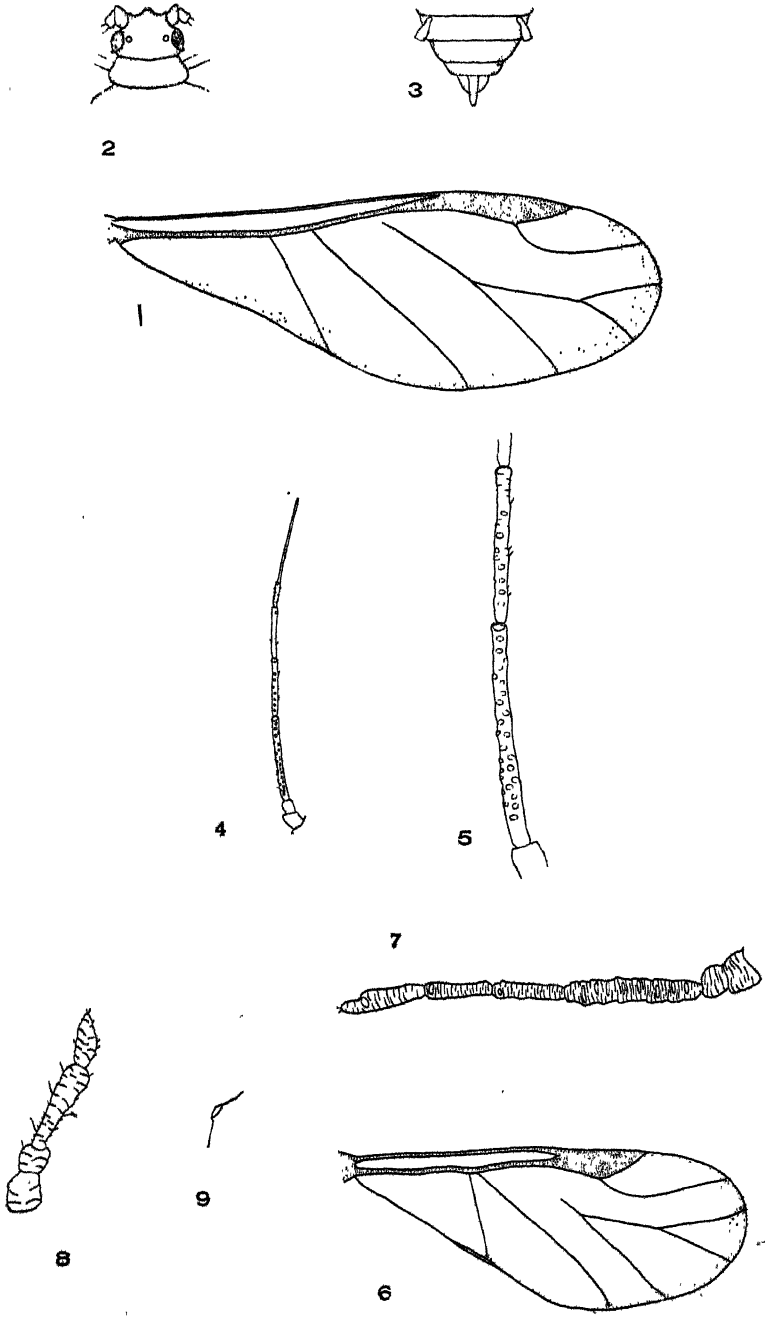
Measurements.—Length of body, 2.2 mm.; breadth of body, 1.22 mm.; antennal joints, I, .06; II, .04; III, .12; IV, .06.

Newly hatched young.—Very pale greenish white. Eyes red. A row of minute black spots down each side of the abdomen. Antennæ three-jointed.

This aphid occurs in galls on leaves and flower- or fruit-stalks on at least two species of manzanita (*Arctostaphylos pumilla* and *A. tomentosa*). The red galls show up very prominently on green leaves of the plant. These galls are of two kinds, one on the leaf, caused by the edge being turned over or the leaf being doubled in the middle and a pocket thus formed after the manner of *Pemphigus populimonilis* Riley, the other formed on the fruit stalk. The latter becomes bullet-shaped and in all the specimens examined contained only one apterous vivipara full of unborn young. In the leaf-galls in August were found only pupæ and occasionally the old shrunken, black stem-mother. On the last day of August the pupæ began to develop into winged forms, but as I left Lake Tahoe at this date, I could not ascertain how these migrated.

Taken at Lake Tahoe, California, in August, 1911, at an elevation of 6,200 feet.

Plate 23



New California Aphids

EXPLANATION OF PLATE 23

Hyadaphis umbellulariæ.—Fig. 1, wing.
Hyadaphis umbellulariæ.—Fig. 2, head and prothorax.
Hyadaphis umbellulariæ.—Fig. 3, caudal end of abdomen.
Hyadaphis umbellulariæ.—Fig. 4, antenna.
Hyadaphis umbellulariæ.—Fig. 5, antennal joints III, IV.
Cryptosiphum tahoense.—Fig. 6, wing.
Cryptosiphum tahoense.—Fig. 7, antenna of the winged female.
Cryptosiphum tahoense.—Fig. 8, antenna of the wingless female.
Cryptosiphum tahoense.—Fig. 9, cornicle of the winged female.
Figures 1–4, 6, magnified 60 diameters; figures 7–9, 150 diameters; figure 5, 160 diameters.

Scientific Note

The Cotton Moth in Connecticut.—I have read with interest the notes in *Science* October 13, page 488, by Prof. H. T. Fernald, and in *Entomological News* for November, page 415, by Dr. Henry Skinner, regarding the occurrence in large numbers of the Cotton Moth, *Alabama* (*Aletia*) *argillacea* Hubn., in the Northern States the latter part of September. In New Haven, Conn., the conditions were much the same as Doctor Skinner described them in Philadelphia. Hundreds of the moths were resting on the walls of the railroad station, and other buildings, especially near the water front, were literally covered. On September 25 I counted thirty of these moths inside a closed trolley car on Whitney Avenue on the way to my office. For several days afterward I noticed them scattered throughout the city, but growing fewer. One newspaper came out with an article stating that the Brown-tail Moth had reached the city in great numbers and threatened to do much damage. During a residence of seventeen years in New Haven I have never before observed or collected this insect, though our collection contains specimens taken in Waterbury by Mr. H. S. Woolley. Such a swarm is certainly unusual.

W. E. BRITTON.

JOURNAL OF ECONOMIC ENTOMOLOGY PUBLISHING CO.

The annual meeting of the stockholders of this Company will be held some time between December 27 and 29, in connection with the meeting of the Association of Economic Entomologists at Washington, D. C. The precise time and place will be announced at the sessions of that Association. Members of the advisory board are hereby notified that it devolves upon them to nominate the elective officers.

E. P. FELT, *President.*
E. DWIGHT SANDERSON, *Secretary.*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1911

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

The last few years have witnessed an earnest effort on the part of the officers of the association to make the most of our annual gatherings. The classification of the papers and the resultant partial limitation of the proceedings in any one session to the presentation of allied subjects, has been of great service in avoiding useless duplication in discussion and has tended toward a more comprehensive treatment of the problems under consideration. The recent introduction of symposial discussions was a most commendable step. A later idea, a tabulation of projects now in progress and the publication of that data early so each member may know of the undertakings of his associates, depends for efficiency upon general coöperation. Last year the report was prepared too late for publication in the December issue. This number, with the report of the committee, should reach most of our members several weeks before the meeting. There will then be an excellent opportunity to fully test this method of stimulating coöperation.

The government work has made Washington a most important scientific center and, as a consequence, the coming meeting will be one of our largest gatherings. We take part there in the proceedings of an assemblage representing the foremost exponents of economic entomology, not only in this country but abroad. Owing to the large number of active workers, rigid restrictions are necessary in the time allotted individual papers. It is perhaps unnecessary to add that there are too many new or unsettled problems to warrant the spending of much time on matters already well understood. There are on the program each year, an increasing number of technical papers which can be discussed intelligently by comparatively few. These conditions make timely the suggestion that authors arrange for one or more to open the discussion. It is easy to provide the party undertaking this, with a copy of the paper in advance. The resulting suggestions or criticisms will be immensely more valuable than the more or less impromptu discussions which have largely obtained in the past.

Reviews

Ticks, a Monograph of the Ixodoidea, by G. H. Nuttall, Cecil Warburton, W. F. Cooper and L. E. Robinson, Cambridge University Press, Part II, Ixodidæ, pages XIX+105-348, May, 1911.

We are glad to announce the appearance of Part II of the above work, Part I of which was issued October 1908. Dr. G. H. F. Nuttall and Cecil Warburton appear as authors of this part. As a separate fascicle of this monograph, a very complete bibliography, compiled by G. H. F. Nuttall, L. E. Robinson and W. F. Cooper, has also recently been issued (July, 1911).

This monograph will be found indispensable to students of this group of animals. On the whole, Part II is rather an improvement on Part I of this work. The arrangement is well adapted to the working Entomologist and for the most part the species are well described and illustrated. This part is divided into two sections. Section I deals with the classification of ticks and Section II with the genus Ixodes. In the first section is given a good historical review of the classification of ticks. The authors adopt the classification proposed by Warburton in 1907 with the addition of the genus Rhipicentor, which was established by Nuttall and Warburton in 1908. The classification proposed appears to the writer to be more satisfactory than any other yet set forth. It is very similar to those classifications proposed by Banks and Dönitz. The discovery of a form (Rhipicentor) which is intermediate between Rhipicephalus and Dermacentor, as pointed out by the writers, would tend to favor grouping Dermacentor and Rhipicephalus close together rather than placing Dermacentor near Amblyomma, as suggested by Banks. The use of subfamily, tribal and group names which are not based upon the oldest genera included thereunder would seem open to criticism on account of not being in accord with the rules of zoölogical nomenclature. The authors have followed Dönitz in suppressing the genera Eschatocephalus, Ceratixodes and Neumanniella and in recognizing Margaropus and Boöphilus as distinct genera. The reëstablishment of the genus Boöphilus is undoubtedly correct; hence the Texas fever tick should receive the old mane *Boöphilus annulatus*. The genus Aponomma is considered a subgenus of Amblyomma. The generic diagnosis accompanied by figures illustrating the principal generic characters is a convenient arrangement. The author and date of establishment of each of the genera would in this connection have been a useful addition.

The first portion of Section II deals with the species of Ixodes systematically; the second portion (24 pages) presents some facts regarding the biologies of the group. The definition of the terms used in description and classification of ticks will be found helpful, especially to those who are not thoroughly familiar with the terminology used in connection with ticks. The key presented for the separation of species of the genus Ixodes appears to have some minor objections, but on the whole it works satisfactorily. Complete synonomy, iconography and references to the literature appear under each species. The immature stages of several species are described and figured for the first time. The descriptions of both larvæ and nymph are inadequate in some cases. This may be largely excused, however, when we consider the difficulty of finding good characters to separate the species in these stages. It would appear that the authors have gone rather too far in the description of immature stages of ticks as belonging to certain species when they were simply collected with the adults of those species and not bred from determined females. As an illustration of the danger to be met with in considering all stages found on a host together as belonging

to the same species, it may be stated that frequently two and sometimes even three different species of Ixodes have been taken from the same host at the same time during investigations conducted by the Bureau of Entomology. The authors are correct, in my opinion, in placing *Ixodes scapularis* and *Ixodes californicus* as varieties of the European *ricinus*. There appears to be no valid reason for the maintenance of *Ixodes nigricans* as a distinct species rather than as a variety of *ricinus*. The material (one female from Death Valley, Calif.) considered by the authors to be *Ixodes pratti* Banks is undoubtedly *Ixodes kingi* Bishopp, as is clearly indicated by the description (of the female) and the illustration. This mistake was brought about by the inclusion by Mr. Banks of two distinct species[1] in the material considered *Ixodes pratti* by him. It might be stated here that Mr. Banks' description of the male of *Ixodes pratti* is based upon the male of *Ixodes ricinus* var. *scapularis*. Hence, the description of neither sex as given by Nuttall and Warburton applies to *Ixodes pratti*.

It is to be regretted that the authors did not have at hand a larger series of a number of the species discussed, to be used in the study of variation and correlation. Although in many of the species but very few or only single specimens have been collected, it would seem that larger series of other species might have been procured for study.

The authors consider that there are 51 valid species and 10 valid varieties and subspecies of Ixodes. Twenty-one species and two varieties are recorded from North America, this being a greater number than from any of the other continents. From this list, *Ixodes canisuga* should be stricken as it does not occur in North America. The authors misquote Mr. Banks on this point (page 214).

The greater portion of that part of the work dealing with biologies of Ixodes is devoted to *Ixodes ricinus*. Much of this matter is compiled from other authors. Brief biological notes (mostly compiled) relating to *Ixodes ricinus* var. *scapularis*, *Ixodes angustus*, *Ixodes pilosus*, *Ixodes canisuga* and *Ixodes pustus* are presented. The assemblage of these biological data will be found helpful particularly as they show how meager is the published information on Ixodes. This may tend to emphasize the need of more exhaustive and accurate investigations on the biologies of this interesting group.

As appendices are reprinted two papers previously published in Parasitology: "The Process of Copulation in *Ornithodoros moubata*" by Geo. H. F. Nuttall and Gordon Merriman and "On the Adaptation of Ticks to the Habits of their Hosts" by Geo. H. F. Nuttall.

F. C. Bishopp.

The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-Tail Moth: A Report of Progress, with some Consideration of Previous and Concurrent Efforts of this Kind, by L. O. Howard and W. F. Fiske, U. S. Dep't Agric., Bur. Ent., Bul. 91, pp. 1–312; plates 28 (several colored) and numerous figures, 1911.

The work with parasites of the gypsy and brown-tail moths has been continued for some six years and has already resulted in some most valuable contributions to knowledge and important modifications in laboratory practice. The above publication is a noteworthy paper on insect parasitism, based on an extended study of

[1] See Bishopp, "On Some New North American Ixodidæ with Notes on Other Species," Proc. Biol. Soc. Wash., Vol. XXIV, page 203.

the parasites of two introduced pests and subsidiary investigations of several native species. An examination of the bulletin shows it to be an important chapter in American entomology with ramifications extending to remote parts of the globe.

The senior author, in the introduction, gives a comprehensive and moderately detailed discussion of previous work in the practical handling of the natural enemies of injurious insects. Much of this is familiar to working entomologists though they will greatly appreciate the assemblage of this data, while for others it is almost essential to an understanding of the problem. The narrative detailing the progress of the work shows a well-planned development and gives an excellent idea of the complexity of the subject and the number of collaborators necessary. The investigation developed marked contrasts between the previous recorded parasites and the species actually reared from imported material. We now have as an outcome of these studies, an authentic list of the parasites and predaceous enemies of the gipsy and brown-tail moths, though no one unfamiliar with the subject has an adequate conception of the prolonged, careful investigations involved in ascertaining the relations of the various species to each other and their hosts. It was found not only necessary to study the parasites issuing from imported material, those attacking the hosts in America, but the work was wisely extended to include field observations upon the natural enemies of these insects in various European countries. The latter procedure proved necessary to a comprehensive understanding of the situation. The data secured abroad may prove invaluable when applied to solving the problems presented in America.

The summary shows that there have been introduced into this country, two egg parasites of the gipsy moth, one Hymenopterous and nine Tachinid parasites of gypsy moth caterpillars, four parasites of the pupæ and one predaceous beetle. The brown-tail moth has not been neglected, two egg parasites, four parasites of the smaller caterpillars, six of the larger caterpillars and three of the pupæ having been imported. The vast amount of material handled during this investigation is shown by the fact that over a million and a half of Hymenopterous parasites, over 63,000 Tachinid parasites and over 18,000 predatory beetles were imported from foreign countries. Each of the more important species, at least, has been the subject of careful investigations designed to ascertain all biological data which might be of service in the work of introducing and establishing these natural enemies. The series of maps show that a number of the imported forms have already attained a wide distribution, and lend much strength to the hope that in a few years the parasites may be of material service. An extended dissemination may be followed by rapid multiplication in the next few years with corresponding benefits. Those most familiar with the work look forward to a favorable outcome of this, the largest experiment in economic biology. The undertaking, while costly, is immensely cheaper than an unending and uneven struggle with hordes of voracious caterpillars strongly established over extensive areas and capable of subsisting upon a great variety of plants

The numerous excellent illustrations, together with the discussions of apparatus and methods, will prove of great service to the working entomologist. The several colored plates, while giving a fair idea of the characteristics of the insects delineated, do not, in our estimation, do justice to the original illustrations. Those responsible for the bulletin are to be congratulated upon having produced a work of such high grade and one destined to be a reliable guide for all subsequent efforts along such lines.

Current Notes

Conducted by the Associate Editor

In the Department of Entomology at the University of Kansas the following additions have recently been made:—Mr. H. B. Hungerford, A. B., University of Kansas, instructor in entomology. On the staff of the state entomologist, Mr. A. J. Spangle assistant state entomologist, and Mr. W. T. Emery, assistant entomologist, both graduates of the University of Kansas. A new research fellowship has just been established by the Board of Regents, and Mr. Roy Fraser, B. S., Toronto, has been elected to this fellowship. There are in the department this year nine candidates for advanced degrees.

According to *Canadian Entomologist*, Dr. C. Gordon Hewitt, Dominion entomologist of Canada, was married Wednesday, October 11, to Elizabeth, daughter of Sir Frederick and Lady Borden. Doctor Hewitt's many friends in the United States unite with those of Canada in "heartiest congratulations and all good wishes for the happiness of himself and his bride."

Dr. W. A. Riley, associate professor of entomology at Cornell University, gave a popular lecture on insects in connection with the dissemination of disease, at the recent meeting of the Ontario Entomological Society at Guelph, Ont.

C. P. Smith, assistant professor of botany at the Utah Agricultural College, and a member of this Association, has resigned his position and entered Cornell University as a graduate student in plant pathology. His address is 404 Union Avenue, Ithaca, N. Y.

According to the *Experiment Station Record*, the following changes have recently been made in the Entomological Department of the New Jersey Agricultural Experiment Station:—Raymond S. Patterson has been appointed assistant entomologist succeeding E. W. Stafford, resigned. E. L. Dickerson has also resigned as assistant to accept a position as instructor in the Newark High School.

On account of a change in political administration C. H. Baldwin became state entomologist of Indiana on November 1, *vice* B. S. Douglass.

Prof. A. L. Lovett, assistant entomologist of the Agricultural Experiment Station, Stillwater, Oklahoma, has resigned to become a member of the staff of Professor A. B. Cordley at Corvallis, Oregon. His place has been filled by the appointment of T. E. McElroy, who has previously been engaged in experimenting with insecticides on southern orchard pests in the employ of William Cooper and Nephews of Chicago. There still remains a vacancy in the department on account of the creation of a new position relative to state orchard inspection.

Professor Alexander D. MacGillivray has resigned his position at Cornell University to accept the assistant professorship of Systematic Entomology at the University of Illinois. The vacancy at Cornell has been filled by the appointment of Mr. J. Chester Bradley as assistant professor of Systematic Entomology.

Mr. J. R. Watson has been appointed entomologist of the Agricultural Experiment Station at Gainesville, Florida, vice Dr. E. W. Berger, who resigned a few months ago to become state nursery inspector.

According to *Science*, the following have been appointed associates in entomology of the Harvard University Museum for five years: Dr. William Barnes, Frederick Blanchard and Andrew Gray Weeks.

The degree of Doctor of Science was conferred on Dr. Henry Skinner by the University of Pittsburgh, Pa., on June 14, 1911. For some time Dr. Skinner has been curator of insects at the Academy of Natural Sciences, Philadelphia, Pa., and was for twenty-one years editor of *Entomological News*.

Mr. A. A. Girault, formerly assistant in entomology at Urbana, Ill., has accepted the appointment of Entomologist, Department of Agriculture, Queensland. His address is Brisbane, Australia.

According to *Science*, "Professor A. J. Cook, the veteran head of the department of biology at Pomona College, Claremont, California, has been appointed by Governor Johnson horticultural commissioner of California. He succeeds Mr. J. W. Jeffrey, who has held the office for seven years. Professor Cook was for many years prior to 1891 connected with the Michigan Agricultural College. He has written a number of books about horticultural subjects and is the author of a manual of apiculture. The position to which he has just been appointed is one of great importance, especially on account of the quarantine measures permissible under the California law, which look toward the prevention of the importation of new insect pests and plant diseases."

Rev. Henry C. McCook, D.D., a well-known Presbyterian clergyman of Philadelphia, and the author of a number of books and popular scientific articles on entomology, died in November at the age of seventy-four years.

Professor R. I. Smith, of the North Carolina College of Agriculture, we learn from *Science*, has accepted a position with the Porto Rico College of Agriculture, taking up extension work in agricultural education. His address after January 1, 1912, will be Mayaguez, Porto Rico.

A recent change in the New Hampshire laws for the control of the gipsy and brown-tail moths has resulted in Governor Bass appointing Professor W. C. O'Kane as state agent in charge of the work, in addition to his duties in the New Hampshire College and Agricultural Experiment Station. Colonel Dearborn, the previous incumbent, retired from office December 4th.

All readers of the JOURNAL will regret to learn that Professor John B. Smith, State Entomologist of New Jersey and Entomologist of the Agricultural Experiment Station, is seriously ill at his home in New Brunswick, N. J., and they will hope for his speedy recovery.

Mailed December 1, 1911.

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ERRATA

Page 239, line 17, for *contharis*, read *cantharsi*.
Page 354, line 24, for *prenolepsis*, read *prenolepis*.
Page 381, line 17, for *pastinacea*, read *pastinacæ*.
Page 381, line 30, for *fruit-*, read *fruiti-*.